8.0 ALTERNATIVES TO PESTICIDE USE AND APPLICATION

8.1 Introduction

The amount of pesticides applied in California is large, and pesticide users would deem all of it to be necessary. A considerable portion of the pesticides applied finds its way into the atmosphere and contributes to the air pollution problem. If there is to be any reduction in air pollution caused by pesticides, it must almost certainly involve shifting to alternative ways of pest control and, to some degree, through using better application methods to ensure that a higher percentage of the pesticide applied reaches the target organism. These alternative methods are discussed here.

8.2 Alternatives to Pesticide Use

8.2.1 Biological Control

Many natural enemies of destructive pests are already being used for pest control, primarily in agriculture,[1] and methods are being developed for using a variety of different organisms for various kinds of pests.[2] The organisms imported for the destruction of pests thus far have been mostly arthropods (insects and related groups), but other organisms have also been used to some degree. For example, fungi have been used to control weeds,[3] fish to control mosquitos[4] and plants,[5] bacteria and viruses to control insects,[6] and various microorganisms to control plant pathogens.[7]

The nature of biological control. The term "biological control" has been defined as "the action of parasites, predators, or pathogens in maintaining another organisms population density at a lower average than would occur in their absence."[8] Biological control is part of the "natural control" through which biotic and abiotic factors operate to prevent a population of organisms from increasing to infinity when the number of offspring produced is greater than the parent stock.

We are not usually aware of the effective operation of biological control, but it becomes apparent in some instances when the balance of the control is disrupted. This kind of disruption has been observed where pesticide applications have decimated the predators of an insect pest and allowed the pest population to increase dramatically.[9]

In a natural biological community, the populations of individual species tend to fluctuate above and below the average density for each species. Some species will remain rare in a given area while others will be abundant. Each population may be said to vary within certain limits about a typical mean density or equilibrium position.[10] A similar dynamically changing population equilibrium is considered to exist among various organisms in an agricultural crop area.[10, 11]

The equilibrium position of a population can be shifted upward or downward by changes in the favorability of the environment. More favorable conditions consist of readily available food, optimal temperature and moisture, etc. Competition for food, predation, parasitism, etc. are unfavorable and can lead to a lowered equilibrium position.[11]

A small number of the pest organisms can be tolerated in essentially every crop and in most other places where pests occur. Often, the level considered tolerable in a crop is the number of pests which would cause damage equal to the cost of controlling or suppressing the pest population. This level of pest infestation is called the "economic threshold."[10] It should be recognized that pests cannot be permanently eradicated by any method except in small isolated areas. The goal of biological control is not to eliminate pests entirely but to keep their populations well below the economic threshold. Therefore, in areas where adequate biological control is operating, the presence of a possible pest organism is not considered to be a problem requiring a control action.

Application of biological control. Since biological pest control functions by the actions of other living organisms, man's activities in applying biological control have been limited to three areas: (1) importation of natural enemies of pests, (2) augmentation of the action of the natural enemies through modification of the environment, and (3) mass-production and release of species capable of destroying members of pest populations.[12] The first of these approaches is preferred since, if it is carried out successfully, the pest may be permanently controlled by the natural enemy with no further action required. The other two approaches require continued action and may be more expensive in the long run. Each of these approaches avoid many of the disadvantages of chemical control methods. There is no chemical contamination of the environment, and development of host resistance is highly unlikely.[12] Damage to nontarget organisms and disruptions of the environmental balance are rare from insects, bacteria, and viruses, the most commonly used natural enemies.[20, 30]

Importation of natural enemies. The term "natural enemies" is used to refer to any insect or other organism which is parasitic or predatory on another, particularly a pest organism.[13] Although exotic natural enemies are often imported to control specific pests which are their natural hosts, they may be useful in the control of other, related pests as well.

A large part of the problem with pests has resulted from the accidental entry of the pest into an area without the parasites or predators which keep them under control in their native habitats. It has been estimated that 60 percent of the major arthropod pest species in the U. S. and more than 60 percent of the plant species recognized as weeds in California are from other countries.[14] The best place to look for organisms capable of destroying these immigrant pests is the pests' native lands where their natural enemies exist. A considerable part of the biological control effort is spent in seeking out and testing such organisms.

It should not be thought, however, that the only species which will attack a pest are those which originated in the same area. The introduced oriental fruit moth Grapholitho molesta (Busck), for example, is reported to be attacked by as many as 56 species of parasites in the United States[15] and 25 in France and Italy.[16]

A successful program for importing a pest's natural enemies requires well trained personnel and an adequate organization to ensure that an appropriate search is made for the right organisms. Necessary safeguards must be taken to prevent the accidental introduction of other harmful organisms.

Although natural enemies of pests are sought in foreign lands, usually where the pests originated if it is known, predatory insects do not always show great host specificity. Bartlett and Van den Bosch[13] recorded some instances in which pests were controlled by insects from other areas. In one case, the grubs of a beetle from Korea and Japan, Anomala orientalis, attacked sugar cane in Hawaii but were controlled by a wasp, Campsomeris marginella modesto (Sm.), which is native to the Philippines.

It has been recommended that multiple importations of various kinds of natural enemies should be made in order to increase the chances of obtaining the best natural enemy of a pest/host in a particular habitat or range of habitats.[12]

Natural enemies which have been found during foreign explorations must be collected and sometimes reared to provide sufficient numbers and shipped to a quarantine laboratory in the destination country. The collector or the quarantine laboratory must study and select natural enemies based on their host preference, other characteristics of behavior, and their life cycle.[13] Such biological control agents must be thoroughly examined for the presence of diseases and secondary parasites which may attack alternate, desirable hosts among native species.[17]

Organisms which show some promise of controlling a pest must be cultured for further testing, mass produced, distributed, and released into areas where damage from the host occurs. Sometimes the imported organism can be colonized, without mass production or elaborate testing to determine its ability to survive, by simply releasing a few individuals in the vicinity of the host. Ordinarily, repeated releases are made at a number of sites selected for environmental diversity. It has been suggested that adverse climate has been responsible for more failures of colonization than any other single factor.[18] Environmental variations may also limit a natural enemy to only a part of the area occupied by its host.

Once a natural enemy of a pest species is established in an area it generally provides some degree of permanent biological control of the host; this may be disrupted by changes in the ecology, primarily those initiated by the actions of man.

<u>The effectiveness of biological control</u>. The biological control of

pests through the importation of natural enemies has worked very well in some instances and less well in others.[12]

In the first well known application of the method, the threatened destruction of the California citrus industry by the insect, cottony-cushion scale, Icerya purchasi (Mask.), was stopped by the vadalia beetle, Rodolia cardinalis, brought from Australia in 1888. The cottony-cushion scale has not been a problem since that time except when the vadalia beetle population has been reduced by insecticide application.[19]

Van den Bosch and Messenger[1] listed 95 species of insect pests and 21 weed pests which have been completely or substantially controlled in different parts of the world by imported insects. The 12 insect pests controlled in California are listed in Table 8-1. Two species of weeds have been substantially or completely controlled in California by imported natural enemies.

On the basis of past experience in importation programs throughout the world, the probability of obtaining substantial or complete control of an insect pest would be 40 percent for any natural enemy imported.[12] This success rate is remarkably high, but it does represent successes among those natural enemies which were selected for import from foreign countries; it does not indicate the degree of success obtained in searching for candidates for importation. In fact, the primary factor responsible for limiting the increase in effectiveness of biological control is reported to be the failure to direct more effort into natural enemy importation programs.[12, 20, 21]

Augmentation of biological control. Natural enemies of pests, whether indigenous or imported, frequently do not keep the host population below

TABLE 8-1

Insect and Weed Pests Which are Completely or Substantially Controlled in California by Imported Natural Enemies.[1]

I. Insects

Pest Species: Common Name	Pest Species: Scientific Name	Crop Affected	Degree of Control[a]
Pea aphid	*Acyrthosiphon pisum* (Harris)	Alfalfa	S
Spotted alfala aphid	*Therioaphis trifolii* (Monell)	Alfalfa	S
Alfalfa weevil	*Hypera postica* (Gyll.)	Alfalfa	S-C
Red scale	*Aonidiella aurantii* (Mask.)	Citrus	S
Yellow scale	*Aonidiella citina* (Coq.)	Citrus	S
Cottony-cushion scale	*Icerya purchasi* (Mask.)	Citrus	C
Citrophilus mealy bug	*Pseudococcus gahani* (Green)	Citrus	C
Black scale	*Saisselia oleae* (Bern.)	Citrus	S
Western grape leaf skeletonizer	*Harrisinia brillians* (B & McD)	Grape	S
Olive scale	*Parlatoria oleae* (Colree)	Olive, disciduous fruits	S-C
Walnut aphid	*Chromaphis juglandicola* (Kalt.)	Walnut	S-C
Nigra scale	*Saissetia nigro* (Nietn.)	Ornamentals	S

II. Weeds

Weed Species: Common Name	Weed Species: Scientific Name	Type of Enemy	Degree of Control
Klamath weed	*Hypericum perforatum* (Linn.)	Leaf-feeding beetles & root borer	C
Tansy ragwort	*Senecio jacobaeae* L.	Leaf-feeding lepidopterau	S

[a] S= Substantial
C= Complete

the economic threshold. There are many possible reasons for this failure. Sometimes the attacking organism may become very rare at some time of the year if it is primarily dependent on a single host species for food. This occurs especially with enemies of pests in annual field crops. After the growing season, suitable stages of the host may not be available until the next year. When the pest population increases again with the next crop, the few natural enemies left are unable to reproduce fast enough to cope with the pest. When predators and parasites are not able to keep a pest under control in this way, it is sometimes possible to increase their effectiveness by: (1) providing alternate areas for host breeding, (2) providing areas for feeding on alternate hosts, (3) providing supplementary food sources,[22] and (4) making periodic releases of the natural enemy.

Before augmentation of natural enemies is attempted, the efficacy of any method should be established by experiments and studies of the life cycles and feeding habits of the pest and their enemies.[23]

Alternate feeding areas for the host or its natural enemy will often consist of weedy fence rows and roadsides which have not been cleared of weeds or other vegetation. For example, there has been much greater control of grape leafhopper by the parasitic wasp, Anagrus epos, in those areas of the central valley of California where blackberry bushes have been allowed to proliferate.[24] The blackberry patches support an alternate host for the wasps during the winter months.

Mass rearing and inundative releases of insects for the practical control of pests is carried out to some extent in the United States; it is reported to be common in the Soviet Union and some other countries.[25]

A number of different insect species have been used in experimental mass releases with varying degrees of success,[25] but the majority of practical releases consist of species of the egg parasite Trichogramma spp. The practicality of releasing insects for pest control depends considerably on the economics of rearing insects since large numbers are needed. In experiments in California, for example, the release of 100,500 T. pretiosum per hectare per week among processing tomatoes gave parasitization rates of 59 to 81 percent in pest insects and reduced fruit damage from a maximum of 8.5 percent to 2.6 percent.[26] Large numbers of lady beetles have been collected in their resting areas and sold to farmers. Usually, these have not been very effective since the beetles have the desire to migrate. They may stay in the release area if they have undergone an appropriate feeding schedule prior to release; some firms supplying lady beetles provide this pretreatment.

Microbial control of pests. Microorganisms provide an additional means of biological control which operates in nature and may be applied for control of both insect and plant pests.[27, 28]

The first work aimed at producing microbial pathogens for insect control was carried out by Russian workers in the 1880s.[29] Beginning about 1940, Bacillus popilliae, a bacterium which causes "milky disease," was used in conjunction with other methods to control the Japanese beetle in the northeastern United States especially.[30]

The pathogen most widely used in biological control is Bacillus thuringiensis var. thuringiensis. This bacterium is sold under the trade names Biotrol, Dipel, Microtrol, and Thuricide. The preparations can be applied as dusts or sprays using the same equipment used for applying chemical insecticides; they can even be mixed with other pesticides.[31, 32] Bacillus thuringiensis is moderately specific; it does not harm beneficial insects and is not toxic to other animals. Sprays must be applied at the proper time and under favorable weather conditions since the preparations must be ingested by insects.[31] Some examples of pest control programs in California that use Bacillus thuringiensis and other pathogens are listed in Table 8-2.

Viruses. The use of viruses to control pests has been under study for some time.[45] One of the most important developments has been the viral insecticides used with some success on the cotton bollworm, Heliothis zea.[33] Nuclear polyhedrosis virus (NPV), used to control Heliothis, is sold by Sandoz under the name Elcar.[46]

Although other viruses have been tested for insect control[47, 48] and the U. S. Forest Service has registered viruses with the Environmental Protection Agency (EPA) for use on gypsy moth and Douglas fir tussock moth, they are not commercially available.[46] One reason for this lack of availability is the pesticide industry's reluctance to become involved. According to Falcon:[33] (1) There are high costs, and a long time-period is required for development and for obtaining EPA registration, (2) After development, the virus cannot be patented, (3) The potential use cannot compete well with chemical pesticides, and (4) The production of viruses is difficult because live insects must be used. Viruses also have a short life when exposed to the ultraviolet radiation of sunlight on foliage. Additives, such as activated carbon, have been used to extend the life of viruses under such conditions.[48]

Although viruses and other microbial pesticides are not used much at

TABLE 8-2

Examples of Insect-Pest Control Programs in California that Utilize Insect Pathogens and Employ Integrated Control Principles.[33]

Crop	Status[a]	Insect Pathogens[b] Natural	Insect Pathogens[b] Applied	Host	Reference
Alfalfa	OP	F		aphid	34
		NPV	NPV, B.t.	caterpillar	
		NPV		armyworm	
Apple	Exp	F	GV	codling moth	35
	OP	F		codling moth	36
Cole	OP	NPV	NPV, B.t.	cabbage looper	37
Cotton	OP	NPV	NPV, B.t.	cabbage looper	38
		NPV	NPV	beet armyworm	39
			NPV	bollworm	
Forest	Exp	NPV	NPV	Douglas fir tussock moth	40
Grapes	OP		B.t.	leafolder	41
				skeletonizer	42
Mosquito Marsh	Exp	F	F	*Aedes sierreusis*	43
Ornamental trees	OP		B.t.	red-humped caterpillar	42
				oakworm, budmoth	44

[a]OP = Operational programs; Exp = experimental programs
[b]B.t. = Bacillus thuringiensis, F = Entomogenous fungi; GV = granulosis virus; NPV = nuclear polyhedrosis virus; NV = noninclusion virus

present, the search for more effective microbial agents by the USDA, other government agencies, and various universities is continuing.

The advantages claimed for the use of microbials over the use of chemical pesticides are:

1. They are not toxic to humans and other organisms;
2. They do not harm beneficial insect enemies;
3. They are not long lasting and do not leave harmful residues in the environment (hydrocarbon solvents are not needed); and
4. They do not readily lead to the development of resistance in target organisms.

8.2.2 Genetical Methods of Pest Control

There are two forms of genetic pest control. In one, the genetics of the pest are altered in some way to make them less able to reproduce; in the second, host resistance to attacks by the pest is developed by cross-breeding. The latter method is also referred to as varietal control.[32] Because of their complexity, both of these methods are largely out of the hands of individual growers and their development must depend on governmental and other research organizations.

Sterile release programs. The eradication of the screwworm from the southern United States is the outstanding example of the successful use of the sterile insect release method (SIRM).[49] The screwworm was eradicated from Florida in 1959 and from other parts of the U. S. by 1965.[50] Since that time, there have been no similar successes of SIRM anywhere in the world, although there have been efforts to apply the method against other insects.[51, 52] Sterile male releases have been made on a continuing basis to exclude the entry of the Mexican fruit fly into southern California.[53]

In the SIRM, insects must be laboratory reared in large numbers and the males are sterilized before they are released to mate with females of the wild population. Successful eradication of an insect using the SIRM requires that: (1) the females must mate only once; (2) the males must not be reduced in competitiveness by the rearing or the sterilization procedures; and (3) the releases must be made in a geographically confined area.[50] Since these characteristics may not apply to more than a small number of insect species in the United States, the SIRM will probably be more useful in suppressing rather than eradicating insect populations; perhaps with the incorporation of delayed sterility or hybrid sterility into the program's objectives.[52]

"Delayed sterility," "hybrid sterility," and "genetic load" refer to characteristics which theoretically can be bred into a line of insects, which, when released to breed with wild insects, could pass these deleterious genes on. This might then lead to a suppression of the species population.[49] These methods have not passed beyond the experimental stage, and their feasibility has not been proven.

Although the SIRMs are ingenious and have received wide publicity for some of the successes attained, it does not appear that the application of these methods will be significant except in a few special cases.

<u>Varietal resistance</u>. Some plant and animal varieties, which are less susceptible to damage from insects and pathogens than other varieties, have been called resistant. The use of resistant varieties to control insects and pathogens has been in progress for many years and is expanding.[54, 55] Using resistant varieties has been called "the ideal method" since no ad-

ditional work or expense is involved once the variety is in the hands of the grower.[56]

If resistance is complete, there is no cost for applying pest controls such as chemical or microbial sprays, and there are no adverse effects on the environment from poisons or spray residues.

In 1968, it was reported that about 75 percent of the acreage in agricultural production in the United States used varieties developed by plant breeders for some form of disease or insect resistance, and in some crops such as alfalfa, the percentage reached 95 to 98.[57]

Plants have been classified as having three basic mechanisms of resistance depending on the reaction of the pest: (1) They may be nonpreferred for food, oviposition, etc.; (2) Resistant plants may have an adverse effect on the pest resulting from their chemical composition or the morphology of the plant; and (3) The plant may tolerate a high degree of infestation by the pest.[58] Resistant varieties of plants and other organisms are developed by exposing a large number of varieties from different sources to the pest and selecting those which show some resistance and then crossing these with other varieties.[55]

In order to expose many different plants to an insect pest, for example, it is necessary that a large supply of insects be available. Frequently, this means that the insects must be reared in large quantities or collected in the field for testing against the plant in the field, laboratory, or greenhouse.[54] An assay system must be established for uniform exposure of the plant material to insect attack, and the plants must be graded for the degree of resistance shown.

Varieties developed for resistance must also have other desirable characteristics such as a high yield and/or resistance to pests other than the one selected. Resistant varieties are often found among wild or exotic species which do not have many other desirable features. In such cases, it is necessary to cross them with other lines repeatedly and make selections in such a way that the resistance genes are transferred into an organism with an overall balance of suitable qualities. If field tests are not made fairly early in the selection process, it is possible to end with a variety which lacks resistance to other pests or does not have suitable economic characteristics.[55, 59]

A large number of plant varieties resistant to insects[55] and plant pathogens[60] have been developed and released. Many of the resistant varieties have greatly reduced the loss to pests. Luginbill[61] (1969) reported that the estimated annual savings in the United States from reduction in loss due to use of varieties resistant to the Hessian fly, to wheat stem sawfly, to European corn borer, and to spotted alfalfa aphid was $308 million. Over a ten-year period, this was calculated to have resulted in a $300 return for each dollar invested in research.

Other varieties which provide only a limited resistance to a given pest have been developed. Although such limited resistance is useful in itself, it also makes it easier to control the pest by other methods such as biological control or use of selective herbicides.[62, 63]

There are some problems involved in the use of host resistance for pest control. One is the failure of permanent control. Pests, especially organisms such as those causing fungus diseases, are sometimes able to overcome the resistance of the host by selection of new biotypes which may arise through mutations.[64, 65] Monogenic resistance is thought to be particularly undependable. Nevertheless, the use of resistant varieties is the main line of defense against some of the plant diseases and new varieties must be developed as others become ineffective. Also there are some varieties which have continued to be resistant over a long time. One of these is an apple tree reported to be resistant to wooly apple aphid in 1831 and which still has this resistance.[59]

Another problem in using host resistance as a control measure is the time required to develop resistant varieties. This time varies from 3 to 15 years and the cost can be high.[59] It is sometimes difficult to find adequate financial and organizational support for such long-term projects though more is becoming available as the need is more widely recognized.[55]

8.2.3 Cultural Control

Cultural control of pests refers to the use of variations from regular procedures of culture which can be put into practice to reduce pest damage. Cultural techniques are probably the oldest and most widely used form of pest control, especially in relation to weed suppression.

Cultural control techniques should be supported by or based on the results of research developed from an understanding of the life cycles and habits of the pest organism. This is true because the tactics used are best designed to take advantage of "weak links" in the pest's life cycle, and the timing of an operation may be critical for its success. Also, the success of an operation may not be easily predictable or even evaluated without careful study.

There are many cultural control techniques currently in use or of potential value. Some are discussed below.

Sanitation. Sanitation involves the removal or destruction of crop residues or other materials which may serve as breeding or overwintering environments for pests. The method can be used effectively against almost every kind of pest whether insects, microorganisms, nematodes or rodents.

For example, sanitation is used to control two cotton pests, the pink bollworm and the boll weevil, by destruction of the cotton stalks soon after harvest.[66] The stalks are shredded and plowed under to prevent regrowth of the plants and the production of food for the pests. The method is said to have little effect on the natural enemies of other cotton pests, such as *Heliothis* spp. and the tobacco budworm.[14]

The borders of fields, ditch banks, and waste areas are possible sources for harboring pests. Removal of weeds, etc. from these areas may help to reduce infestation from alternate hosts. Destruction of weeds in waste areas should be undertaken with caution, however, since they may be important areas for the maintenance of the natural enemies of pests.

The practice of rotating crops is well established and is primarily effective in controlling pests and diseases which cannot survive for long periods in the absence of the susceptible host crop. It is effective against nematodes, soil fungi, and against some insects and weeds. Continuous culture of one crop, year after year, can cause a build-up of disease organisms or other pests which can become increasingly destructive. An example of this is the bean root rot fungus, *Fusarium*, and other fungi which can be controlled by rotation with barley.[57]

Some nematode problems are economically controlled only through the use of crop rotation. The sugar beet cyst nematode in the Imperial Valley of California is controlled by only allowing the growth of sugar beets in uninfested fields for two years in a row or four out of ten years and only one out of four years in infested fields.[14]

Crop rotation programs for the control of corn rootworms in the midwestern United States stipulated that corn should not be grown for two successive years on the same land. Under this program, the rootworms were considered a minor pest. With introduction of organochlorine pesticides, crop rotation was abandoned but resumed after rootworms increased following their development of resistance to the insecticide.[14]

Tillage. Until herbicide chemicals were developed, tillage was the only method of weed control other than hand pulling. There has been some shift towards a reliance on herbicides in recent decades and some development of the practice of minimum tillage. Under ordinary circumstances, yields have not been found to increase from the use of cultivation.[14]

Tillage can cause a reduction in the number of some insect pests through mechanical injury and exposure. For example, damage from the wheat stem sawfly was reduced up to 75 percent by cultivation.[67] The effects of microorganisms in the soil can be modified by tillage which allows the ground to dry out faster and to warm sooner than untilled soils.[7] The use of tillage to control pests should be carefully evaluated since many enemies of insect pests can also be destroyed by the practice.

Trap crops and alternate hosts. Trap crop systems involve the use of an early planting of a crop, such as cotton, in a small strip. The trap crop may be baited with a pheromone to draw boll weevils or other insects from adjacent fields which are later to receive the main crop. The cotton in the trap strip (which may be 5 percent of the field) is then sprayed with an insecticide which has no harmful effect on the natural enemies inhabiting the other 95 percent of the field.[68]

Providing an alternate host plant may reduce loss to pests. Lygus bugs in California will infest both cotton and alfalfa, but they prefer alfalfa where they do little damage. If alfalfa is planted next to the cotton, the Lygus bugs move to the alfalfa.[69] In order to keep the bugs there after the frequent cutting of the alfalfa, the alfalfa is cut in strips so that only half of it is cut at any one time. The strip cutting of alfalfa also permits a larger population of different natural enemies of pests to survive than if the whole field is cut.

Time of planting. One of the most satisfactory methods of control is to vary the time of planting to avoid the time of greatest pest density. There should be no additional expense to the grower and should have no adverse effects on the environment.

Before the development of the newer organic pesticides, the planting of early maturing cotton to escape the late season attacks of boll weevils constituted the primary control method.[21]

The planting of crops in irrigated areas to promote growth during periods of no rain is a method widely used to avoid fungus diseases.

8.2.4 Physical Control

Physical control involves the use of direct and indirect mechanical or manual measures to control pests such as insects and weeds or to render the pests' environment unsuitable for their survival. These control measures include: employing mechanical and radiation devices, use of adhesive substances, constructing barriers, and manipulating temperatures. Many of the physical methods of pest control formerly used in the field have been replaced by chemical control methods in more developed nations though they are still being used in less developed areas.[70]

Construction of barriers is among the most popular physical methods used to control pests. Ditches and furrows can be used to prevent the migration of cinch bugs and army worms. Metal barriers are effective means for detering subterranean termites. Screened windows and doors, and other enclosures are effective barriers to mosquitoes, moths, and many other bothersome insects.

High temperatures are sometimes used to destroy pests usually found in stored products such as grains.[69] Insects are killed at about 60^{o}C or by a 3- to 4-hour exposure at 52^{o}C to 54^{o}C. Steam is frequently used to sterilize equipment and soil in greenhouses. Propane or oil flamers have been useful, in some situations, for weed control and for destroying weevils and their eggs in alfalfa stubble; this has allowed some growers to reduce the number of chemical sprays needed. Flaming has some obvious disadvantages. It destroys many of the natural enemies which help to control pests, and hydrocarbons and other substances are released to the atmosphere.[72]

Mechanical means of pest control include the removal of insects from plants by hand, and, in a more recent innovation, removal with sprays of a mild soap solution in water.[73] Cultivation to remove weeds and the formerly widespread use of summer fallow of land with frequent tillage are measures used for the mechanical disruption of weeds.

Electromagnetic radiation of various wavelengths has been proposed for pest control. Lights which attract or repel insects are the most commonly used radiation devices. Black-light (ultraviolet) traps are employed in agriculture primarily for sampling insect populations; their use has also been suggested to control the corn borer, the corn earworm,[74] and some insect pests of tobacco.[75] A microwave device is reported to have been developed and tested for the control of weeds and other pests on vegetables and other crops.[76]

The use of adhesive substances is a successful means of controlling pests in some instances. The use of fly paper is a well-known example of this method although it has been largely replaced by chemical emitters. Sticky or greasy bands around the trunks of trees are effective for controlling the larvae of gypsy moths, cicadas, and cankerworms, as well as ants and some other insects.

8.2.5 Hormonal Control

Insect hormones. Insect growth regulators have been studied for possible use in controlling insects.[77, 78] They appear promising because of their high specificity, the small amounts needed, and their low toxicity to other animals and plants.[79]

The growth and development of insects is controlled by three major hormones: the brain hormone, the molting hormone (ecdysone), and the juvenile hormone. The brain hormone stimulates the secretion of the molting hormone (MH); juvenile hormone (JH) is released into the blood at the same time as MH is released. Secretion of MH initiates the molting process, and JH prolongs juvenility by delaying the maturation of tissues.

The specific hormone which is required at one stage must be absent at other times if normal insect development and maturation is to occur. If applied externally, JH, or insect growth regulator (IGR) can prolong the period of immaturity or result in the production of additional immature stages (instars).[80] The immature forms usually die without reproducing, although they may grow large and do more damage by consuming additional food.

There is not a great deal known about the potential of using IGRs to control populations in many insect groups. Mosquitoes are the most studied in this regard and one JH product has been registered for experimental use against floodwater mosquitoes in the United States.[78] A single product may also be effective against other species since all JH chemicals have structural similarities.

To be effective, JH must be applied at the proper stage of the insect's life cycle. This may be its most serious shortcoming; this has been partially overcome by the use of slow release capsules.[81]

Insect growth regulators are chemicals which are applied in much the same way as other insecticides, but they differ from other insecticides in that they are effective at lower concentrations (aircraft applications of 0.025 lb/acre have controlled Aedes nigromaculis), and they have little effect on other organisms. Although it is presumed that there is less likelihood of target insects developing a resistance to IGRs, there are some cases where resistance has developed.[82] The IGR itself should have little effect on atmospheric hydrocarbon emissions as they are biodegradable and unstable in sunlight; however, the amount of such emissions would depend on the carrier used.

One of the main hindrances to the development of IGRs for insect control is the reluctance of companies to embark on a development program in view of the uncertainty of IGR's economic efficacy. A considerable part of the investment for such a program would have to be used to meet government regulatory requirements.[78]

Insect attractants (pheromones). Insect attractants or behavior-modifying chemicals (called "pheromones" if they originate in the insect) have received considerable study in recent years.[83, 84, 85] Hundreds of these insect behavior chemicals have been identified,[86] but none are being produced for general use in crop protection.[87]

Some of the major uses or potential uses of insect attractants are: to monitor for the presence of insects in an area, to determine the densities of insects in an area, and to use in actual control procedures.

Traps baited with attractants are already used in monitoring for the presence of insects. For example, the USDA used traps baited with synthetic lures to detect the accidental importation of the Mediterranean fruit fly, the melon fly, and the oriental fruit fly.[88] The use of traps to determine population densities has not been entirely satisfactory since the number of insects in a trap may not be closely related to the severity of an infestation.

Mass trapping and the disruption of the pheromone-guidance system by air permeation with the attractant are the methods being tested for controlling insect populations. Mass trapping appears to be effective when the insect population is relatively low, and it may be useful in preventing a population build-up. If the insect population is already high, the traps may capture a large number of insects but not enough to reduce the population to economic threshold levels.[88]

Field experiments with the communication disruption method suggest it may be the most effective way to use attractants for control purposes although general usefulness of the method has not been established. In one experiment, gossyplure, a sex pheromone of the pink bollworm, was continuously evaporated during the growing season in all cotton fields of the Coachella Valley of California, but the number of larval infestations of the cotton bolls after treatment were about the same as those that occurred in previous seasons when fields received conventional insect control treatments.[83]

An important characteristic of pheromones is that they are specific; only one species or several closely related species respond to the same chemical. This is a distinct advantage since other beneficial insects would not be affected. In most cases, however, crops are infested with more than one economically-important insect, and the use of control agents specific for only one of them could be a distinct disadvantage. Fortunately, experiments indicate that combinations of pheromones which affect different species can be effective;[89] this is a situation which adds considerable promise to the effectiveness of using pheromones in pest control.

8.3 Alternative Pesticide Application Methods

In most pesticide applications, little of the pesticide applied actually reaches the site of action within the target pest. A large percentage of a pesticide is lost during and after the application. A schematic description of the typical losses between the spray nozzle and the site of intoxication is shown in Figure 8-1. The percentage loss figures shown do not represent one specific case but were composited from several field studies.

If the use of a pesticide, starting from the application to the toxic

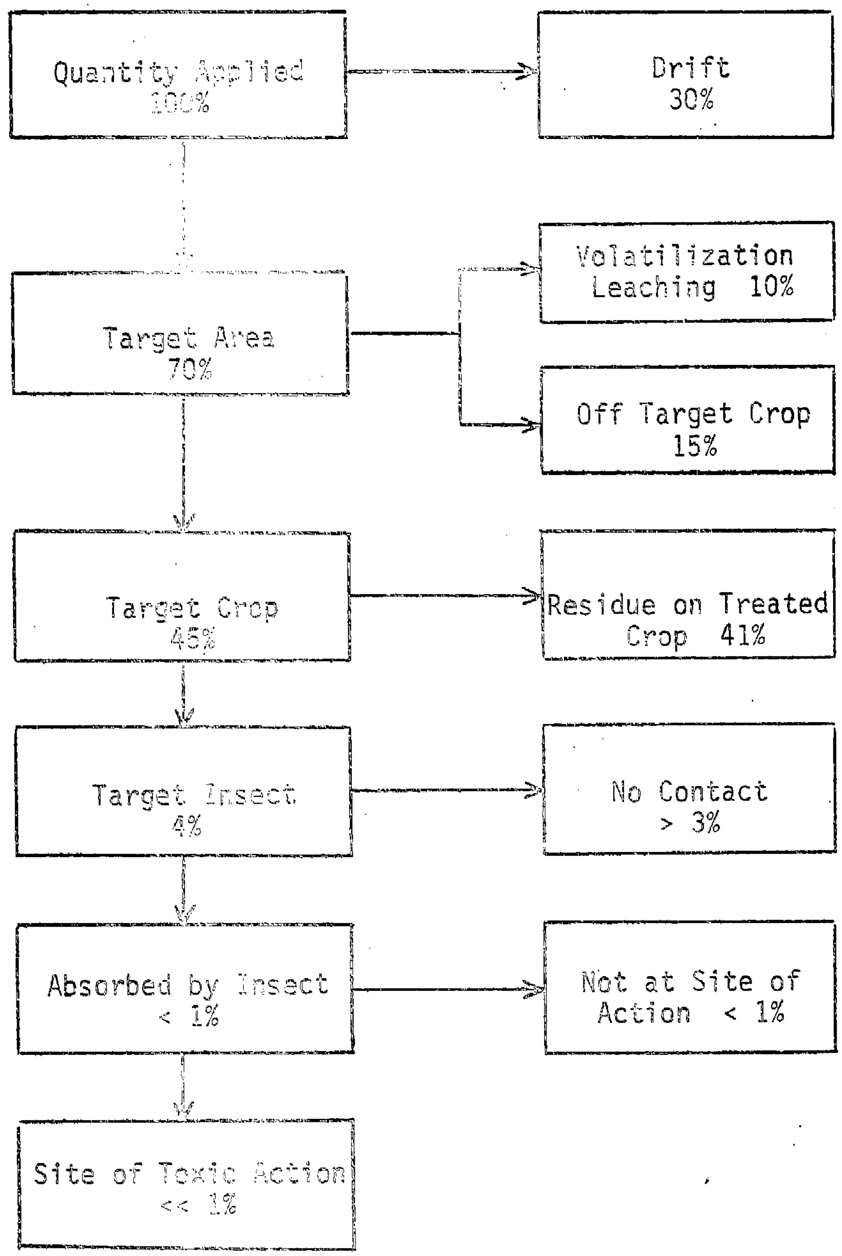

Figure 8-1. Percentage Distribution of Typical Losses of Pesticides between Spray Nozzle and Site of Toxic Action.[90]

action inside the target pest, could be made more efficient and less wasteful, a smaller amount of pesticide could be applied, and less pesticide would be emitted into the ambient air. However, in a practical, operational, or economic sense, most of the pesticide losses depicted in Figure 8-1 are unavoidable at present. Only those approaches to pesticide application that may reduce or eliminate avoidable wastes and losses which result from unnecessary use, overuse, misuse, or improper planning will be considered here.

Drift control. Pesticide drift is the movement of a pesticide to places other than the intended target area. If the drift of sprayed pesticide can be reduced, less pesticide will be required, and therefore, less pesticide will be emitted into the ambient air.

The particle size distribution of the spray is probably the most important factor contributing to off-target drift. Large droplets that have an appreciable fall velocity will fall out within a short range while small droplets with negligible fall velocity may be dispersed over a larger area before hitting the ground. Table 8-3 shows the theoretical drift of droplets of different sizes under different atmospheric conditions. All of the water droplets (sp. gr. = 1) are assumed to be falling at terminal velocity for a vertical distance of 20 ft. and to be displaced horizontally by an average wind speed of 5 mph. Since the particulate sizes involved with dusts are generally smaller than those with liquid sprays, drift during application is an even greater problem with dusts. It is obvious that drift can be controlled better if the size distribution can be shifted toward larger particles. However, less pesticide is required to cover a given surface area if particle size can be reduced. Smaller

TABLE 8-3

Theoretical Drift Distance (No Evaporation) of Water Droplets Falling 20 ft. in a 5 mph Wind.[98]

Droplet Diameter (μm)	No Turbulence	Intermediate	Turbulence
1000	1.5 ft.	11 ft.	9.3 ft.
500	6.0 ft.	24 ft.	13.1 ft.
100	150 ft.	152 ft.	29.3 ft.
50	600 ft.	336 ft.	41.5 ft.
10	2.8 miles	0.4 miles	92.7 ft.
5	11.4 miles	0.88 miles	131 ft.
1	284 miles	5.6 miles	293 ft.

droplets would provide a greater total surface area than would larger droplets (see Table 8-4). In a practical or economic sense, the size distribution of droplets should be controlled in a way that the least amount of pesticide is applied. The droplet sizes should be small enough to cover the area without using excess pesticide but large enough to control drift. The objective for achieving effective control, therefore, is to produce a uniformly small droplet size sufficiently large enough to control drift under the conditions of application.

Drift control can be accomplished in four ways: (1) reduction of very small droplet formation, (2) reduction of evaporation, (3) prevention of droplet dissemination, and (4) reduction of drift distance.

1. Reduction of very small droplet formation. Droplet-size distribution can be regulated by modifying the design of spray devices and by changing the physical properties of the spray solution. The thinner the spray sheet after it leaves the nozzle opening, the finer the spray produced. Droplets of very small size are therefore usually produced under high nozzle pressures and with great fan angles. In order to eliminate the formation of very small droplets, nozzle pressure and fan angle should be carefully adjusted. The nozzle should not point forward on airplanes or on ground rigs. The drift of a sprayed liquid weed killer or insecticide away from the target area can be greatly reduced by blowing hot gas or steam across an ordinary spray nozzle.[92] Very small droplets can be effectively eliminated from a spray by simply attaching a hot gas generator or a steam generator. If the drift of sprayed solution can be reduced, up to 40 percent less chemical is required to cover an area.

The droplet size can be increased by adding thickeners to sprays to

TABLE 8-4

Total Surface Areas of Spray Droplets
of Different Sizes Per Gallon of Spray.[98]

Droplet Diameter (μm)	Number of Droplets ($x\ 10^6$)	Total Surface Area (m^3)
1,000	7	23
500	58	46
100	7,230	227
50	57,830	454
10	7,230,000	2,270
5	57,830,000	4,540
1	7,230,000,000	22,700

increase their viscosity. These thickeners increase the droplet size by increasing the thickness of the spray sheet.

2. Reduction of evaporation. Reducing the evaporation from spray droplets can reduce hydrocarbon emissions by reducing both the evaporation of solvent from droplets and the formation of very small droplets. This can be achieved by using less volatile diluents and by adding evaporation suppressants to the spray solution.

3. Prevention of droplet dissemination. Preventing spray droplets from disseminating also reduces the formation of very small droplets. This can be achieved by modifying the design of the sprayer nozzle and by changing the physical properties of the spray solution.

4. Reduction of drift distance. If the drift distance can be reduced, less pesticide is required to cover an area, and pesticide evaporation from sprayed droplets is reduced. The drift distance can be reduced by lowering the height of the sprayer nozzle. It is obvious that the closer the nozzle is to the sprayed surface, the less chance there is for air currents to carry the sprayed droplets away. The best way to do this is by avoiding wide nozzles, spacings, and narrow fan angles.[93] However, it is possible that, with some methods of aerial application, a larger amount of pesticide would drift away if the application height is too low. This may be due to the severe turbulence caused by the aircraft slipstream and is reflected by a swirling pesticide deposit pattern in the swath area.

Selection of application methods. Aerial applications usually show a higher potential for drift than do ground applications when spraying similar droplet sizes. However, there is a strong economic incentive for a large ranch to use aerial application methods.

Pesticide can be applied aerially by three methods: water-diluted emulsifiable concentrate, low-volume, and undiluted ultra-low-volume. Water is added to the emulsifiable pesticide product to make a water-diluted emulsifiable concentrate which is applied at a high rate. Low-volume application involves the use of undiluted technical formulations. Ultra-low-volume applications use specially formulated, concentrated products which are applied at an especially low rate. Ultra-low-volume sprays, usually applied as smaller particle sizes than low-volume sprays, are generally more suceptible to drift. However, a smaller amount of pesticide is used in an ultra-low-volume spray. Ultra-low-volume sprays do need special formulations which have a low volatility. Water diluted emulsifiable concentrate droplets, although initially large, rapidly lose size and weight through evaporation of the water and become more subject to drift.

Pesticide formulations. In California, most of the pesticides applied by commercial applicators are in the form of spray formulations. The shift from dust formulations to spray formulations should be encouraged mainly because it can reduce the drift hazards due to a significantly larger particle size spectrum.

The physical properties of a spray solution can be changed by reducing the quantity of small droplets emitted. The major physical properties related to droplet size are surface tension, viscosity, density, and vapor pressure. These physical properties can be changed by modifying the pesticide formulation.

As was noted earlier, the potential for drift may be reduced by using thickening agents to reduce the number of fine droplets.

The thinner the spray sheet after it leaves the nozzle opening, the finer the spray produced. Thickening agents are natural or synthetic polymers that are soluble in water and increase its viscosity. Several other adjuvants can also modify the viscosity of an agricultural spray.

Meteorological considerations. Pesticide drift is a direct result of the transport of sprayed droplets by atmospheric movement. Meteorological parameters that affect drift are wind direction, wind velocity, turbulence, air temperature, humidity, radiation, precipitation, and stability of the ambient atmosphere.[94]

Local wind patterns should be carefully studied before the application of pesticides. It is of prime importance to have the pesticide fall in the target area. However, since wind direction can change during the spraying operation, some type of visual indication of wind direction should be installed at the application site. The spray operation must be stopped immediately if the wind direction changes.

High wind tends to carry a large portion of sprayed pesticide away from the target area; drift problems can be minimized by spraying only when the winds are light. The horizontal distance that a pesticide is carried is directly proportional to the wind velocity. MacCollom[95] found that the best time to spray was when the wind velocity was 6.4 to 8 km/hr. However, the wind velocity profile varies with surface roughness and atmospheric stability. These should be measured to provide the information necessary for calculating the transport of pesticides near the ground surface.

It is very important to avoid spraying a pesticide under strongly turbulent conditions. Although Table 8-3 shows that very small droplets are not transported as far away from the target area under turbulence as they are under conditions of no turbulence, a large amount of pesticide is still required because the turbulence makes it more difficult to apply a pesticide to a target area.

Air temperature, humidity, and solar radiation may affect the evaporation rate of the sprayed droplets. The size spectrum of these droplets would be shifted toward finer particles as evaporation occurs. Relative humidity has a great affect on water-based sprays. Sprayed droplets evaporate more quickly under conditions of low humidity. Fine droplets of a wettable powder-water suspension may even become floating dust on a low humidity day if they do not reach the target quickly enough. With non-aqueous solvents and pesticides where humidity has little effect on the evaporation rate, air temperature and radiation are the major meteorological factors affecting evaporation.

As Table 8-5 shows, the evaporation rate for small droplets is surprisingly high.[96] A 50-micron droplet of pure water at 86°F in an atmosphere of 50 percent relative humidity will evaporate in 3.5 seconds; this droplet would fall 1¼ inches during this time. It is obvious that meteorological factors that affect the evaporation rate of sprayed droplets should be carefully studied before pesticides are applied.

Rain-out is an important mechanism for removing some of the fine pesticide aerosols that are carried into the atmosphere. On the other hand, pesticides applied to vegetation and in open fields may be washed away by precipitation. Pesticide applications, therefore, cannot be conducted before or during a rainstorm. Weather forecasts of precipitation should be closely followed.

Air temperature profiles that have a lower lapse rate than the adiabatic

TABLE 8-5

Evaporation Rate of Water Droplets
at 86^{o}F in an Atmosphere of 50% Relative Humidity.[96]

Droplet Diameter (μm)	Lifetime (sec)	Distance of Fall (ft)
200	56	69
100	14	6
50	3.5	0.1

lapse rate are commonly referred to as inversions which dampen vertical displacements and produce stable conditions. Any temperature lapse greater than the adiabatic lapse is called super adiabatic and produces unstable conditions in which less dense air parcels near the ground surface accelerate upwards to a position of equilibrium. Although less vertical movement of sprayed pesticide would occur under a stable condition, a well-mixed layer may exist near the ground with an inversion layer persisting aloft. Recent tests confirm that the pesticide concentration downwind of a target area is higher during inversion conditions than during unstable conditions.[94, 95] The best time to spray a pesticide should be during the absence of inversion conditions. A strong inversion may exist during the night, early morning, or late afternoon.

Timing of pesticide application. Pesticides must be applied during the "weak stage" in the pest's life cycle. Herbicides should be applied only during the preemergence and postemergence periods. However, most pesticide applications today are regarded as a part of routine practice for certain commodities. Almost exactly the same types and amounts of pesticides are applied year after year.

Soil incorporation. It has been shown that incorporating pesticides into the soil can have a substantial effect on their efficacy and persistence. Pesticide evaporation can also be substantially reduced using this method. Therefore, pesticides which are applied to open fields should be incorporated into the soil immediately after application. Maximum performance of herbicides sprayed for subsequent incorporation into the soil can be obtained only by uniformly mixing the herbicides into the surface layer.

8.4 Alternatives to Weed Oil Application

In addition to those alternate application methods discussed in the previous section, the following methods may be considered as alternatives to weed oil applications. Some of the methods referred to here were also discussed in Section 8.2 (Alternatives to Pesticide Use).

Preventative weed control. Preventative weed control encompasses all measures taken to forestall the introduction and spread of weeds. Since no preventative measure can be expected to eliminate all of the numerous species of weeds found on any given land, prime attention should be given to those methods that are most likely to return the most favorable results for the effort expended.

Planting weed-free seeds can help to avoid the introduction of weeds. Weed-free seeds can be produced in selected areas where the most thorough and effective weed control procedures available are applied. Conversely, seeds that come from an ordinary field are rarely clean. Weed seeds mixed in with crop seeds must be separated out on the basis of their physical differences.[14, 19] Such differences include size, weight, shape, surface area, density, stickiness, pubescence, texture, color, and electrical properties.

Farm equipment used in each step of crop-seed handling should be cleaned before use. Special attention should be given to the movement of farm animals since many weeds are disseminated by seeds that adhere to animals or that can survive the digestive processes of animals. Soil materials should be inspected before they are moved. Irrigation or runoff from rainfall often carries weed seeds. Organized community programs may be required to prevent this type of weed infestation.

Some undesirable alien species may spread with astounding rapidity. Rigid seed inspection procedures and vigilance in detecting incipient infestations are essential for early detection. In certain cases, quarantine--an extreme weed control measure--may be a necessity. Intensive surveys and rapid destruction are the only possible methods to eliminate infestations caused by windborne seeds.[97, 98]

Physical methods. Tillage control is an important physical weed control measure. Tillage may remove weeds from soil, weaken them through root pruning or other injury, or bury them. Tillage reduces or eliminates weeds which may compete with the crop for moisture, nutrients, light, and carbon dioxide; it can be implemented manually or mechanically.[14, 97]

Mowing and cutting are also practical methods for weed control by controlling weeds in two ways. If properly timed, mowing prevents weeds from producing seeds. Repeated mowings also aid in establishing perennial plants which are generally small and produce weak seedings. Manual implements used in mowing are gradually being replaced by mechanized equipment.[97]

Flooding has long been used to reclaim land from perennial weeds by smothering them under water. This method is commonly used for weed control in water-tolerant crops such as rice and taro. While it can be used to control many weeds, aquatic weeds may become a problem after flooding. Dredging, draining, and chaining are methods used to control aquatic weeds. Dredging is seldom used because it is an expensive control method. Therefore, it is used only to physically remove excessive silt where extensive weed growth occurs. Drainage of canals and swamps is an inexpensive method of controlling weeds; it simply dries up their habitat. Chain dragging was a method used widely in the past to remove aquatic weeds from irrigation canals. A chain, pulled by tractors, was used to tear out or pull the submerged vegetation from the substrata. Weeds broken loose by chains were carried downstream to a collection point where they were removed from the canal.[97, 98]

The smothering method can also be used to reduce the photosynthetic capacity of weeds. Mulching materials such as straw, sawdust, bark dust, paper, or a plastic sheet can be used to reduce or prevent the transmission of light to the weeds. They also serve as a seal for fumigants and as a moisture barrier, and usually increase the soil temperature. The major disadvantage of this method is the high cost of these mulching materials.[99]

Biological methods. Biological control is based on the fact that there are other organisms capable of killing or controlling certain weeds. Natural enemies of weeds include a wide range of organisms: insects, vertebrates, microbial pathogens, and parasitic higher plants. The major disadvantages of using this method are that it cannot be used to control a complex of many weeds, and the host specificity risk may be too great.

Insects have received the most attention because of their great variety, high degree of host specialization, intimate adaptations to hosts, and stable dynamic control. To be an effective agent in the control of a weed, an insect should be able to kill the host plant or prevent its reproduction, have the ability to disperse and locate the host plant, be able to adapt to the environment, and have sufficient reproductive capacity. St. Johnswort or Klamath weed controlled by *Chrysolina quadrigemina* at Blocksburg, California is an excellent example of using an insect for the biological control of a weed.[98, 99]

Habitat-management systems. Weeds compete with crops for light, soil moisture, soil nutrients, and/or carbon dioxide. Since weeds are generally vigorous plants, they frequently win when competing with other plants. Most habitat-management techniques rely heavily of subtle differences between weeds and crops and manipulate these differences in the way to give crops an edge over weeds. Important differences between crops and weeds involve their life cycles, specific growth habits, variations in morphology and physiology, environmental influences and biotic factors that affect weeds differently than crops.[98]

Soil manipulation, cropping practices, and manipulation of the water supply are often used to make the environment more suitable for the growth of crops. Seed bed preparation, minimum tillage, post-planting tillage, and fallow methods are used most frequently to manipulate the soil to reduce the population of weed seeds and to control established perennial weeds.

Many cropping practices affect weed control. A crop variety may have competitive advantages over weeds. Crop rotation may control weeds with life cycles that are not compatible with the cultural practices used for one of the crops. Irrigation and rainfall also affect weed control because they have a direct effect on soil moisture.[97, 98]

Chemical methods. For many of the weed control problems for which chemicals are applied, there are no effective and economical substitutes at this time. A stand of weeds usually contains more than one species. Biological control methods may not be appropriate for weed control except under unusual circumstances. Additionally, noncropland areas frequently contain rough terrain and are usually untilled; tillage and most other physical methods of weed control cannot be easily applied. Herbicides may be used to replace weed oils in most weed control applications. From a photochemical-air-pollution point of view, less hydrocarbon emissions would result from the use of synthetic herbicides rather than weed oils because a smaller amount of hydrocarbon would be applied. For every control problem for which weed oil is now recommended, there are usually several synthetic herbicides available as registered alternatives. This is true whether the application is for cropland or noncropland areas such as ditch banks, roadsides, fence rows, and railroad right-of-ways.[100]

If synthetic herbicides are substituted for weed oils, appropriate selection of an herbicide would be necessary with regard to its selectivity, its contamination of the environment, and the health hazards it may present. Each of these are already of concern and must be considered when applying the available herbicides; to some degree, they are subject to regulation. In addition, many effective herbicides are "slightly toxic" toward mammals, biodegradable, and relatively nonpersistant.[101]

Nevertheless, other factors, in addition to acute mammalian toxicity, should be considered before any direct recommendation is made to shift from the use of weed oils to other herbicides. These other factors include: the effects of long-term low-level toxicity, the mobility of individual herbicides in the environment, and the amounts of these synthetic herbicides which would be added to the environment.

8.5 Integrated Pest Management

Integrated Pest Management (IPM) is a pest control strategy which attempts to use all available control methods in the least environmentally-destructive manner. The emphasis on methods having a low environmental influence is based on an awareness of the natural controls that operate to maintain a balance among populations of pests and other organisms. All currently available methods are included in the plan because it is recognized that, in many situations, only chemical control can maintain a pest population below the economic threshold especially if its population must be reduced quickly once the threshold has been exceeded.

The application of ecological principles was advocated as the most effective approach to pest control as early as the latter part of the nineteenth century and has had its proponents through the first half of this century.[102] The development of the concepts of integrated pest management, however, began after the discovery of synthetic organic pesticides in the mid-1940s.[14] It has had its greatest impetus from attempts to find methods of pest control which avoid the serious problems which arose due to the over reliance on these organic pesticides.

The main problems which were a source of concern resulting from the use of organic pesticides were: (1) development of resistance, (2) target pest resurgence, (3) induced secondary pest outbreaks, and (4) environmental contamination. Many insect pests have developed resistant strains following repeated treatments with pesticides. Sometimes this led to higher and higher rates of pesticide application. By 1975, 75 percent of the major insect pests of California agriculture had developed resistance to at least one pesticide.[103] Target pest resurgence refers to the increase in population of a pest species to a density which is greater after spraying than it was before spraying with a pesticide to control it. This occurs when the pesticide used kills the pest's natural enemies more efficiently than it destroys the pest. After this, the few pest organisms which escaped destruction are able to multiply unhindered and reach a greater density in the absence of their natural enemies.

Secondary pest outbreaks occur when spraying to control a primary pest decimates the natural enemies of another potential pest. With its population thus released from effective biological control, the secondary pest can multiply to a point requiring a control action.

Pesticide contamination of various portions of the environment does occur. The present study is an attempt to assess one aspect of this contamination--its effect on the concentration of reactive hydrocarbons in the atmosphere. Some persistant pesticides like DDT were found almost everywhere in the environment; because of this, DDT has been banned for most uses in the United States since 1972. The use of a few other persistant pesticides has been severly restricted, but environmental contamination problems still exist. There are frequent news reports of illnesses from pesticides among agricultural workers; these usually are a result of misuse. There were 1452 cases of illnesses due to pesticide exposure reported to the California Department of Food and Agriculture in 1976.[104]

The IPM concept has been proposed as a way of controlling pests which avoids those problems associated with the use of pesticides. However, an important component of the IPM concept is the principle of diversity. It is thought that unilateral use of any method to the exclusion of others may lead to unforseen and undesirable side effects.[105, 106] Environmentally compatible methods which are acceptable for IPM programs have been discussed earlier; they include: (1) biological control using parasites and predators,

(2) genetic control using resistant varieties and the release of sterile insects, (3) cultural control, and (4) hormonal control.

An additional category that should be added to the list of acceptable methods is the appropriate and selective use of pesticides. A key aspect of the practical application of IPM is that pesticides should not be applied by rote, i.e., according to a predetermined time schedule which is to be followed regardless of the status of the pest or other factors. Under IPM there must be a monitoring process (sometimes called "scouting") to determine the status of any potential pest. When the number of healthy individuals reaches a point where it may exceed the economic threshold, then and only then is a control action such as pesticide treatment ordered.

The procedure described seems simple enough, but a great deal of knowledge and experience is required to make the right decisions. First the monitoring of any individual species on a crop, for example, must be done according to a procedure established by experimentation carried out, generally, in the same local area. The decision of whether a control action is necessary may also depend on the time of year as well as growth stage of the crop, the number and life stage of the pest's natural enemies, the presence and status of other potential pests and their enemies, the weather, and other factors.[14]

An IPM program developed for cotton in the San Joaquin Valley of California is an example which shows the importance of timing and the presence of more than one pest to effective control. The lygus bug is a key pest of cotton in this area. When insecticide spray treatments were made periodically throughout the season to control the lygus bug, other insects such as the beet armyworm, the cabbage looper, and especially, the cotton bollworm became serious problems which required additional pesticide treatments. Research showed that the lygus bug could only cause serious damage to the cotton crop during the budding season, usually about June 1st to mid-July. Insecticide treatments for lygus bugs were unnecessary and were avoided after that time. The cotton bollworm and other pests became less of a problem. The later spray treatments for lygus had been killing the bollworms natural enemies which had often led to serious outbreaks of these pests.[39]

Integrated Pest Management is now used in only a small percentage of the attempts at pest control. Its use is increasing, and especially in California, it is being applied to more and more agricultural crops.[107] A clearer idea of its benefits is emerging from this increased use. Usually, the cost of applied insecticide has been reduced by 50 percent or more. For example, pear growers who used IPM in the Sacramento River district saved an average of $49.37 per acre on pesticide applications when compared with non-IPM users' expenses.[108] A study in the San Joaquin Valley showed that cotton growers who use pest management consultants obtained yields averaging $22.00 more per acre and spent 58 percent less for pesticides during 1970 and 1971 than growers not using such consultants.[109] In a continuation of this study, however, the net profit of cotton and citrus growers was not found to be significantly different over the period 1970 to 1974, regardless of whether they used pest management consultants or not.[110]

DeMichele and Bottrell[111] stated that IPM experts have estimated that a 40 to 50 percent reduction in the most environmentally-polluting insecticides would occur within 5 years after adoption of currently available IPM systems. A reduction of 70 to 80 percent is predicted within ten years after the adoption of these programs.

A reduction of this magnitude obviously would have a very significant impact on reactive hydrocarbon emissions from pesticide use even though no special effort is being directed toward that goal. However, there is some indication that, although they may be the largest pesticide source of hydrocarbon emissions, IPM researchers may not consider petroleum oils to be a serious problem in environmental pollution.[112, 113] If air-polluting emissions from pesticide applications are to be reduced, a special effort aimed specifically at this problem will probably be required. It was noted above that IPM is being used only by a small fraction of pest control users. Although IPM seems to have many advantages over a reliance on strictly chemical methods, IPM is not being implemented rapidly. There are two main reasons for this: (1) there is a lack of proficient IPM specialists who, by law, are required for the application of IPM methods in most cases, and (2) there is a reluctance on the part of growers and others to change to IPM methods.[14] The reasons that growers do not want to shift to IPM include: (1) IPM is more complicated and not as easy to understand as conventional pesticide application methods, (2) the decision on when to apply control actions must generally be left to a pest control specialist, (3) a fear that crops may be lost if they do not apply chemicals in the usual way, and (4) a lack of understanding of the probable benefits to themselves and the environment which may accrue from use of IPM.[14, 114]

The use of IPM will undoubtedly increase; this is evidenced by the amount of support and publicity it is currently receiving. Federal support may be among the most influential forces to bring this about. A five year research effort, sometimes called the Huffaker project, was started in 1972 with funds from the National Science Foundation, EPA, and USDA. The goal of this project was to develop improved methods for pest control in alfalfa, citrus fruits, cotton, pome and stone fruits, and soybeans.[115] EPA is continuing, as is USDA, to plan and to conduct research and pilot projects in this area and to help coordinate efforts among other governmental agencies and private organizations which are working to develop pest management systems.[116]

8.6 Conclusions and Recommendations

The appropriate use of alternative pest control methods can very significantly reduce the need for application of chemical pesticides without appreciable reduction of agricultural output. In some cases cosmetic quality could be reduced.

Some of the alternative measures are being used and have been used in most agricultural practices despite displacements by pesticides. Losses to pests have been reduced by applications in each of the major areas of pesticide alternative methods--biological control, genetical control, physical control, and hormonal control. The use of biological control and resistant plant varieties alone are estimated to be responsible for the prevention of losses to pests of several hundred million dollars anually in the United States. The decrease in the need for pesticide application and the resultant hydrocarbon emission would be considerable.

California has been a leader in development and implementation of some forms of pest control such as biological control of pests through the importation of natural enemies. A list of thirteen important California pests which have been completely or substantially controlled by imported enemies was shown in Table 8-1. A bacterial insecticide is widely used on some crops and an insect hormone, Gossyplure, is receiving intensive testing against the pink bollworm of cotton. Many disease-resistant plant varieties are being developed especially in universities. To whatever degree alternatives to chemical pesticides of this kind can be implemented, they offer the greatest opportunity for reduction of hydrocarbon application and emission since very little or no hydrocarbon chemical is involved.

There should be a continuation of the development and improvement of these alternative control methods which are for the most part made through research at colleges and universities and the U. S. Department of Agriculture which are the organizations primarily involved in such development programs.

Integrated Pest Management (IPM) is a method which incorporates all pest control methods but emphasizes the concept that natural biological controls should be interfered with as little as possible, and therefore, that pesticides should be applied only as experience shows they are beneficial. The use of IPM can usually reduce pesticide applications by 50 percent or more in those crops where methods are developed. IPM is largely unexploited both with regard to development of methods for many crops and implementation of methods already developed.

IPM should, in general, be encouraged with a view to reduce reactive hydrocarbon emissions. Lowered emissions would result from most, but not every, IPM development. In some cases there may be a larger use of petroleum oils, unless the goal of reduced emissions is incorporated into the development programs.

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APPENDIX A

CALIFORNIA AIR RESOURCES BOARD (CARB) REACTIVITY CLASSIFICATION OF ORGANIC COMPOUNDS

CALIFORNIA AIR RESOURCES BOARD (CARB) REACTIVITY CLASSIFICATION OF ORGANIC COMPOUNDS

Class I (Low Reactivity)	Class II (Moderate Reactivity)	Class III (High Reactivity)
C_1-C_2 Paraffins	Mono-Tert-Alkyl-Benzenes	All Other Aromatic Hydrocarbons
Acetylene	Cyclic Ketones	All Olefinic Hydrocarbons (including partially halogenated)
Benzene	Alkyl Acetates	Aliphatic Aldehydes
Benzaldehyde	2-Nitropropane	Branch Alkyl Ketones
Acetone	C_3+ Paraffins	Cellosolve Acetate
Methanol	Cycloparaffins	Unsaturated Ketones
Tert-alkyl Alcohols	N-alkyl Ketones	Primary & Secondary C_2+ Alcohols
Phenyl Acetate	N-methyl Pyrrolidone	Diacetone Alcohol
Methyl Benzoate	N,N-dimethyl Acetamide	Ethers
Ethyl Amines	Alkyl Phenols[a]	Cellosolves
Dimethyl Formamide	Methyl Phthalates[b]	Glycols[a]
Perhalogenated Hydrocarbons		C_2+ Alkyl Phthalates[b]
Partially Halogenated Paraffins		Other Esters[b]
Phthalic Anhydride[b]		Alcohol Amines[b]
Phthalic Acids[b]		C_3+ Organic Acids + di acid[b]
Acetonitrile[a]		C_3+ di acid anhydrides[b]
Acetic Acid		Formin[b] (Hexa methylene-tetramine)
Aromatic Amines		Terpenic Hydrocarbons
Hydroxyl Amines		Olefin Oxides[b]
Naphthalene[a]		
Chlorobenzenes[a]		
Nitrobenzenes[a]		
Phenol[a]		

[a]Reactivity data are either non-existent or inconclusive, but conclusive data from similar compounds are available; therefore, rating is uncertain but reasonable.

[b]Reactivity data are uncertain.

APPENDIX B

SURVEY COVER LETTERS

AND QUESTIONNAIRES

(1st AND 2nd SURVEYS)

STATE OF CALIFORNIA

EDMUND G. BROWN JR., Governor

AIR RESOURCES BOARD
1102 Q STREET
P.O. BOX 2815
SACRAMENTO, CA 95812

December 13, 1977

RE: Source Questionnaire

Dear Sir:

The California Air Resources Board has contracted with Eureka Laboratories, Inc. of Sacramento, California to conduct a study concerning emissions of volatile organic chemicals from the active ingredients, diluents, and carriers associated with the application of pesticides in Fresno County. This survey is designed to determine the quantities of photochemically reactive hydrocarbons emitted into the ambient air as a result of such applications in Fresno County for the 1976 calendar year for both agricultural and non-agricultural purposes. From the information you and other respondents provide, the approximate emissions can be determined.

We would appreciate your cooperation in completing this questionnaire and returning the completed questionnaire in the enclosed, pre-addressed envelope as soon as possible to: Eureka Laboratories, 401 N. 16th Street, Sacramento, CA 95814, (916) 443-3932. Your cooperation in providing the requested information will contribute materially to the Air Resources Board's accurate assessment of the hydrocarbon emissions from pesticide use.

If you have any questions regarding the nature and purposes of this survey, please contact Mr. Robert Reynolds, ARB Project Officer, at (916) 322-7690.

If you have any questions regarding the questionnaire and its completion, please direct them to Eureka Laboratories, Inc.

Thank you for your assistance.

Sincerely yours,

John R. Holmes

John R. Holmes, Ph.D.
Chief, Research Division

COUNTY OF FRESNO

DEPARTMENT OF AGRICULTURE
mas E. Corn
Agricultural Commissioner
Ronald Atmajian
Assistant Agricultural Commissioner

DATE: December 6, 1977

TO: FRESNO COUNTY GROWERS AND PESTICIDE DEALERS ADDRESSED

FROM: Robert V. Emparan
Deputy Agricultural Commissioner

SUBJECT: A Study to Determine Air Pollution Emissions Associated with Pesticide Applications in Fresno County.

This memorandum will serve to introduce Steve Leung, President of Eureka Laboratories, Inc. Eureka Laboratories was awarded the contract to conduct this study by the State of California Air Resources Board.

The proposed study will be primarily concerned with the inventory of reactive hydrocarbon emissions and related compounds resulting from pesticide applications in Fresno County for the 1976 calendar year.

We will appreciate your cooperation with Eureka Laboratories in developing this information. It is an important project that we consider to be necessary to thoroughly understand all aspects of air pollution in Fresno County.

If you have any comments or questions about this project please contact us at 209-453-5960; or the Eureka Laboratories, Inc., 401 North 16th Street, Sacramento, CA 95814 -- phone: 916-443-3932.

Thank you for your kind consideration in this matter.

Thomas E. Corn
Agricultural Commissioner

Robert Emparan

Robert V. Emparan
Deputy Agricultural Commissioner

1730 South Maple Avenue, Fresno, California 93702 • (209) 453-5960

1976 PESTICIDE APPLICATION SURVEY FOR DISTRIBUTORS

A. Name of Dealership ______________________________

Address ______________________________

B. Person to contact about questionnaire ______________________________

Title ______________________ Telephone ______________________

C. Inventory of pesticides sold for use in Fresno County in 1976 (including weed oil, petroleum distillate, and any other organic diluents sold to farmers, commercial applicators, home owners, and government agencies).*

Registration No. (or Brand Name)	Amount Sold in 1976	Usage (Agricultural, Structural, Home, Garden, etc.)	Registration No. (or Brand Name)	Amount Sold in 1976	Usage (Agricultural, Structural, Home, Garden, etc.)

*Existing documents providing equivalent information to the questionnaire are also acceptable.

1976 PESTICIDE APPLICATION SURVEY FOR FARM OWNERS/MANAGERS

A. Location of pesticide application(s).

Township ______________ S. Range ______________ E.

B. Time of day pesticides most commonly applied (check one).

( ) 0000-0600 ( ) 0600-0900 ( ) 0900-1200

( ) 1200-1500 ( ) 1500-1800 ( ) 1800-2400

C. Pesticide applied by (check one)

( ) you or your employees ( ) professional applicator ( ) both.

D. Method of application most commonly used.

( ) air, ( ) ground, ( ) other, specify ______________________________

E. Pesticide Supplier(s) ______________________________

F. 1976 Pesticide Application Record*

Date	Pesticide Name (Registration No.)	Pound Per Acre	Total Acreage Treated	Commodity Treated	Grower Applicator or Commercial Applicator

*Existing documents providing equivalent information to the questionnaire are also acceptable.

EUREKA LABORATORIES, INC.
Toxicology, Energy, Environmental and Chemical Research
401 NORTH 16TH STREET SACRAMENTO, CA., 95814
TEL.(916) 443-3932

April 24, 1978

Dear Sir:

This is a follow-up questionnaire survey to our earlier one dated December 13, 1977 (see attachments). We want to thank many of you for providing us with information on 1976 pesticide sales in Fresno County. In this follow-up survey, we are requesting information specifically on sales of petroleum oils and coal-tar oil.

We would appreciate your cooperation in completing the questionnaire and returning it in the enclosed pre-addressed envelope to us as soon as possible. Your cooperation in furnishing the requested information will provide an accurate technical basis to the Air Resources Board in formulating strategies for hydrocarbon emission inventory.

Thank you for your cooperation and assistance.

Sincerely,

EUREKA LABORATORIES, INC.

By Steve K. Leung
Steve K. Leung, D. Env.
President

agr

Attachments

cc Dr. John Holmes, ARB
Mr. Robert Emparan, Fresno County Agriculture Commissioner

1976 PETROLEUM OILS AND COAL-TAR OIL APPLICATION SURVEY

A. Name of dealership ______________________________

Address ______________________________

B. Person to contact about questionnaire ______________________________

Title ______________________ Telephone ______________________

C. Were petroleum oils or coal-tar oil sold by your company for agricultural usage in 1976? Yes___ No___

If no, please return the questionnaire using the enclosed envelope.

If yes, please complete the questionnaire and return.

D. Inventory of petroleum oils and coal-tar oils sold for agricultural usage in Fresno County in 1976 (including summer or spraying oils, winter or dormant oils, weed oils, petroleum or coal-tar solvents, supreme oils, paraffinic or aromatic hydrocarbons, coal-tar fractions: light, carbolic oil, creosote, and anthracene oil; and peat oils):

Name of Product (or Registration No.)	Amount Sold in 1976 (Gallons)	Major Supplier of the Product

E. Approximately, ______% of these oil products was sold directly to users (instead of other distributors) in 1976.

______% of these oil products sold in 1976 was used in Fresno County (instead of other counties).

APPENDIX C

PESTICIDE GROUP LIST*

R = Restricted Chemicals

NR = Nonrestricted Chemicals

NR-R = Nonrestricted Chemicals Used as Minor Active Ingredients in Restricted Products

*Pesticide chemicals are identified as R, NR, or NR-R based on a 1977 list of restricted chemicals provided by the California Department of Food and Agriculture.

I. Insecticides

I-A Halogenated Hydrocarbons

Chlordane (R)

Chlorbenzilate (NR)

Dieldrin (R)

Endosulfan (R)

Heptachlor (R)

Kelthane-R (NR)

Methoxychlor (NR)

Tetradifon (NR)

Toxaphene (R)

I-B Organophosphates

Acephate (NR)

Azodrin-R (R)

Bidrin-R (R)

Carbophenothion (R)

Dementon (R)

Dialifor (R)

Diazinon (NR)

Dimethoate (NR)

Dioxathion (NR)

Di-Syston-R (R)

Dursban-R (NR)

Dylox-R (NR)

Ethion (R)

Fenthion (NR)

Guthion-R (R)

Imidan-R (NR)

Malathion (NR)

Meta-Systox (NR)

Methyl Parathion (R)

Monitor-R (R)

Naled (NR-R)

Parathion (R)

Phorate (R)

Phosalone (NR)

Phosdrin-R (R)

Supracide-R (R)

TEPP (R)

I-C Carbamates

Aldicarb (R)

Baygon-R (NR)

Carbaryl (R)

Carbofuran (R)

Formetanate Hydrochloride (NR)

Methomyl (R)

Morestan-R (NR)

I-D Formamides

Fundal-R (NR)

I-E Others

BTB (NR)

Omite (NR)

Plictran (NR)

II. Fungicides

II-A Carbamates

Benomyl (NR)

Maneb (NR)

Nabam (NR)

Topsin-M-R (NR)

Zineb (NR)

Ziram (NR)

II-B Substituted Aromatics

Botran-R (NR-R)

Carboxin (NR)

Chlorothalonil (NR)

Dowcide-A-R (NR)

Dyrene-R (NR)

PCNB (NR-R)

Tetrazole-R (NR-R)

Thiabendazole-R (NR)

II-C Dicarboximides

Captan (NR)

Difolatan-R (NR)

II-D Others

Sec-Butylamine (NR)

III. Herbicides

III-A Organoarsenates

DSMA (NR)

MSMA (NR)

III-B Chlorophenoxy Acids

2,4-D (R)

2,4-D Amine Salt (R)

2,4-D Butyl Ester (R)

4(2,4-DB) Butoxyethanol Ester (R)

4(2,4-DB) Isooctyl Ester (R)

MCPA Dimethylamine Salt (R)

MCPA Isooctyl Ester (R)

III-C Substituted Amides

Alachlor (NR)

Diphenamid (NR)

Kerb-R (NR)

2-(Alpha-Naphthoxy)-N,N-diethyl propionamide (NR)

Propanil (R)

Ramrod-R (NR)

III-D Nitroanilines

Balan-R (NR)

Cobex-R (NR)

Trifluralin (NR)

III-E Ureas

Diuron (NR)

Linuron (NR)

Monuron (NR)

III-F Nitro Heterocyclics

Amitrole (NR)

Atrazine (NR)

Bromacil (NR)

Prometone-R (NR)

Pyrazon (NR)

Simazine (NR)

III-G Substituted Aliphatic Acids

Dalapon (NR)

Sodium TCA (NR)

Glyphosate, Isopropylamine Salt (NR)

III-H Arylaliphatic Acids

Fenac (NR)

2,3,6-TBA Dimethylamine Salt (NR)

Dacthal-R (NR)

III-I Phenols

DNBP (NR)

III-J Bipyridyls

Diquat Dibromide (NR)

Paraquat Dichloride (R)

III-K Carbamates

Avadex BW-R (NR)

Barban (NR)

CDEC (NR)

CIPC (NR)

Eptam-R (NR)

IPC (NR)

Ordram-R (NR)

Tillam-R (NR)

Phenmedipham (NR)

Ro-Neet-R (NR)

III-L Substituted Nitriles

Bromoxynil Octanoate (NR)

Dichlobenil (NR)

III-O Others

1-(5-Tert-Butyl-1,3,5-Triacliaz) (NR)

Calcium Cyanamide (NR)

Endothall (NR)

Oryzalin (NR)

Planavin-R (NR)

Profluralin (NR)

Tok-25-R (NR)

Unknown #1929 (NR)

IV. Nematocides

Chloropicrin (R)

DBCP (R)

D-D Mixture (NR)

Ethylene Dibromide (NR)

Methyl Bromide (R)

Telone-R (NR)

V. Plant Growth Regulators

Ethephon (NR)

Gibberellins (NR)

Maleic Hydrazide, Diethanolamine Salt (NR)

VI. Adjuvants

Alkyl and Alkylarypoly/oxyethyl Ether (NR)

Carbolic Acid (NR)

2-Chloro-4-Phenylphenol (NR)

Diethylamine Salt of Coconut (R)

Ethoxylated Linear Alcohol (NR)

Nonylphenol polyoxyethylene (NR)

Sodium Xylenesulfonate (NR)

Triethanolamine (R)

Vinyl Polymer (NR)

VII. Defoliants

Cacodylic Acid (NR)

Sodium Cacodylate (NR)

VIII. Inorganics

Ammate (NR)

Blue Vitriol (NR)

Borax (NR-R)

Calcium Chloride (NR)

COCS (NR)

Copper (NR)

Copper Hydroxide (NR)

Copper Oxide (NR)

Copper Oxychloride Sulfate (NR)

Copper Salts (NR)

Copper Sulfate (NR)

Copper-Zinc Sulfate Complex (NR)

Cryolite (NR)

Diammonium Phosphate (NR)

Disodium Octaborate Tetrahydra (NR)

Lead Arsenate (R)

Lignin Sulfonic Acid (NR)

Lye (NR)

Magnesium Sulfate (NR)

Phosphorous (NR)

Phostoxin-R (R)

Sec-Butylammonium Phosphate (NR)

Sodium Arsenite (R)

Sodium Chlorate (NR)

Sodium Metaborate (NR)

Sulfur (NR-R)

Sulfuric Acid (NR)

Vikane-R (NR)

Zinc Phosphide (R)

Zinc Sulfate (NR)

IX. Nonsynthetic Petroleum Products

Aromatic Petroleum Solvents (NR-R)

Mineral Oils (NR)

Petroleum Distillates (NR-R)

Petroleum Hydrocarbons (NR-R)

Petroleum Oils, Unclassified (NR)

Xylene (NR-R)

Xylene Range Aromatic Solvents (NR-R)

X. Inert Organic Ingredients (Formulation Code 04)

Aromatic Petroleum Distillate (NR)

Benzene (NR)

Butyl Mercaptan (NR)

Butyrolactone (NR)

Cyclohexanone (NR)

Dibutyl Disulfide (NR)

Emulsifiers (NR)

Epichlorohydrin (NR)

Hexane (NR)

Isofuron (NR)

Isopropanol (NR)

Kerosene (NR)

Methyl Isobutyl Ketone (NR)

Methyl Oleate (NR)

Technical Inerts (NR)

Xylene (NR-R)

XI. Inert Organic Ingredients (Formulation Code 09)

Butyrolactone (NR)

Cyclohexanol (NR)

Diesel Oil (NR)

Diethylene Triamine (NR)

Dupanol (NR)

Emulsifier (NR)

Ethylene Glycol (NR)

Isopropanol (NR)

Methyl Cellosolve (NR)

Methyl Isobutyl Ketone (NR)

Paraffin (NR)

Propylene Glycol (NR)

Technical Inerts (NR)

Toluene (NR)

Xylene (NR-R)

APPENDIX D

MONTHLY DISTRIBUTION OF PESTICIDE APPLICATION

TABLE D-1. 1976 MONTHLY DISTRIBUTION OF SYNTHETIC ORGANIC PESTICIDE PRODUCTS FOR ACREAGE APPLICATION IN FRESNO COUNTY. THE UPPER NUMBER IS LBS.; THE LOWER NUMBER IN () IS ACREAGE.

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
INSECTICIDES													
Chlordane	544 (272)	7210 (3627)	62772 (19737)	716 (272)								2701 (1350)	73943 (25258)
Chlorbenzilate							118 (118)	118 (118)	550 (550)				786 (786)
Dieldrin		185 (1000)	167 (728)	3 (43)				16 (89)	36 (96)	342 (76)			754 (2032)
Endosulfan		2 (2)	216 (267)	374 (566)	2954 (3911)	14630 (16134)	24138 (26685)	9014 (7507)	3025 (3596)	2255 (2849)		1 (2)	56609 (61519)
Kelthane-R				10418 (453)	18963 (9942)	42598 (36906)	33616 (24786)	6701 (6291)	704 (683)	43 (13)	30 (7)		113073 (79081)
Methoxychlor			6724 (3000)	2390 (2362)	1173 (1393)	77 (51)	158 (198)	758 (997)	171 (152)				11451 (13653)
Tetradifon						110 (330)	1803 (4119)	14 (110)					1927 (6486)
Toxaphene	1692 (422)	227 (57)			1224 (352)	45249 (11051)	76061 (21324)	66106 (19419)	16797 (4257)	1386 (450)	32 (8)	871 (362)	209645 (57702)
Acephate							69 (88)	129 (158)	5498 (7549)	1124 (908)			6820 (8703)
Azodrin-R				107 (170)	14668 (18044)	27655 (26770)	3041 (4224)	21 (30)					45492 (49238)
Bidrin-R		178 (237)		128 (170)	4012 (6052)	1561 (3247)	2240 (3651)	1270 (1451)	20 (29)				9409 (14837)
Carbophenothion			28 (109)	133 (209)	515 (745)	617 (912)	903 (1136)	23 (24)					2219 (3185)
Demeton			11 (30)	12 (79)	16 (91)	51 (488)	886 (886)	76 (244)	308 (319)				1370 (2137)
Dialifor				286 (258)	12656 (11455)	9564 (8620)	1156 (1041)	47 (41)					23709 (21415)
Diazinon	3134 (1509)	4151 (2665)	6466 (13259)	11292 (17908)	14622 (13792)	1552 (700)	1845 (1415)	8499 (13225)	3925 (8219)	12 (6)	739 (465)	2721 (1451)	58958 (74614)
Dimethoate	102 (51)			357 (242)	28066 (20923)	64556 (36266)	46756 (32852)	14691 (23637)	2896 (6453)	504 (1446)	17 (37)	59 (177)	158104 (122084)
Dioxathion					1539 (1209)	176 (176)							1715 (1385)
Di-Syston-R				16859 (13110)	1218 (1798)	11 (7)	301 (393)	1731 (1888)	225 (264)				20395 (17460)
Dursban-R						1088 (2175)	6147 (12255)	1691 (3381)	526 (526)				9452 (18337)
Dylox-R						1455 (1436)	1344 (1329)	4032 (3989)	1046 (1270)				7877 (8024)
Ethion					3745 (1470)	3673 (3190)	6541 (6282)	3772 (3545)	766 (596)				18497 (15083)
Guthion-R				29 (62)	7325 (4806)	733 (682)	2915 (3453)	1115 (1287)	70 (72)				12237 (10362)
Imidan-R	355 (171)	156 (129)	6380 (6331)	2727 (2622)	1156 (657)	1293 (842)	3227 (3026)	1043 (1030)				525 (260)	16857 (15068)
Malathion			37 (7)	843 (370)	191 (106)	6569 (1945)	8515 (3149)	2980 (1021)	2032 (809)	25064 (3519)			46231 (11026)
Metasystox			27 (51)	149 (299)	170 (346)	375 (938)	2687 (6291)	2993 (6586)	2872 (5692)		52 (106)	303 (620)	9628 (20929)
Methyl Parathion	91 (91)	1 (2)	1884 (2344)	9067 (38333)	1375 (4961)	2075 (3291)	3583 (3310)	12123 (16544)	4285 (13446)	341 (1428)	25 (113)	198 (406)	35048 (84269)
Monitor-R						14 (28)	5252 (8846)	25815 (39230)	198 (276)	217 (285)	91 (91)		31587 (48756)
Naled				234 (156)	274 (777)	1427 (1200)	25513 (25092)	35568 (35662)	5292 (5205)	143 (394)	16 (34)		68487 (68520)
Parathion	5663 (2887)	11126 (6717)	9510 (6911)	9154 (22264)	7407 (8877)	5364 (4281)	5557 (4270)	7285 (11842)	10008 (18217)	2379 (5433)	438 (511)	1433 (969)	75334 (93179)
Phorate	2921 (2950)	1721 (2007)	10571 (10877)	33338 (36925)	10047 (10515)	754 (454)	1645 (794)	5036 (5045)	1870 (1992)	166 (169)	81 (91)	399 (488)	68549 (72307)

TABLE D-1. CONTINUED

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
INSECTICIDES (Continued)													
Phosalone					679 (424)	108 (56)	1365 (475)	43 (14)					2195 (969)
Phosdrin-R	182 (182)	629 (1587)	1875 (3510)	3314 (6240)	1975 (6031)	368 (698)	2585 (4790)	1585 (3872)	3633 (8160)	8944 (13804)	1516 (2191)	227 (272)	26833 (51337)
Supracide-R	28 (16)	141 (79)	7 (3)	93 (173)	4839 (6857)	4355 (4133)	7833 (11787)	6924 (9268)	2044 (810)	202 (83)			26466 (33211)
TEPP					510 (380)	3161 (2306)	20077 (12213)	5738 (2699)					29486 (17598)
Aldicarb			1158 (2573)	1622 (2513)	1471 (813)	17175 (8776)	1947 (1113)	14 (5)					23387 (15793)
Carbaryl			1304 (923)	853 (590)	4035 (2105)	6444 (3128)	15767 (8298)	20956 (11983)	3523 (3307)	100 (183)	250 (93)	39 (11)	55271 (30621)
Carbofuran		136 (272)	6255 (13806)	1147 (3133)	650 (2562)			23 (91)					8211 (19864)
Formetanate Hydrochloride			571 (534)		1540 (2170)	10110 (15680)	13739 (22331)	2235 (3473)		2 (14)			28197 (44202)
Methomyl			1793 (3568)	1341 (2038)	1629 (3196)	5332 (11195)	26648 (49753)	26600 (51929)	12332 (21093)	5787 (11339)	4853 (298)	21 (9)	86336 (154418)
Morestan-R				28 (30)	540 (705)								568 (735)
Fundal-R					1239 (557)	1010 (830)	13649 (15652)	41651 (45882)	1086 (1086)				58635 (64007)
STB			11 (323)	0 (37)	4 (320)	21 (1810)	78 (3649)	38 (2581)	75 (5884)	251 (16640)	18 (950)		496 (32194)
Omite		108 (86)		36 (12)	7551 (3965)	39903 (25112)	202572 (107142)	90108 (53189)	922 (729)	2016 (1593)			343216 (191828)
Plictran-R				4 (6)	165 (263)	656 (817)	2520 (2997)	709 (897)	171 (227)				4225 (5207)
SUBTOTAL:	14712 (8551)	25971 (18465)	117767 (93893)	107059 (152147)	160143 (152570)	321930 (236661)	574797 (441263)	409366 (390274)	38906 (121564)	51378 (60732)	8158 (4995)	9498 (6377)	1889685 (1687492)
HERBICIDES													
DSMA				166 (73)	4859 (2692)	5024 (508)	279 (123)	333 (146)					10661 (3542)
MSMA					63 (44)	167 (176)	349 (249)	369 (145)		195 (249)			1143 (863)
4(2,4-DB) Butoxy-ethanol Ester			10 (30)								206 (146)		216 (176)
2,4-D		6146 (6776)	2128 (2302)					314 (130)	805 (335)	1906 (738)	583 (277)	267 (295)	12149 (10853)
2,4-D Amine Salt	163 (182)	30705 (35849)	60705 (71994)	109 (227)						227 (250)	1032 (865)	1624 (1740)	94565 (111107)
2,4-D Butyl Ester			3149 (2242)										3149 (2242)
4(2,4-DB) Dimethyl-amine Salt	42 (37)		266 (300)										308 (337)
4(2,4-DB) Iso-octyl Ester	506 (441)	522 (449)	959 (873)							66 (45)	217 (150)	249 (216)	2519 (2174)
MCPA Dimethyl-amine Salt		2506 (4770)	3650 (8517)										6156 (13287)
Alachlor					1409 (413)								1409 (413)
Diphenamid	6367 (2193)	1783 (457)	294 (93)										8444 (2743)
Kerb-R								678 (853)		187 (149)	1225 (879)	478 (605)	2568 (2486)
2(α-Naphthoxy)-N,N-diethyl propionamide	7345 (5250)	2353 (2068)	255 (340)	12 (36)						880 (439)	264 (107)	860 (507)	11969 (8747)

TABLE D-1. CONTINUED

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
HERBICIDES (Continued)													
Propanil					3808 (1207)	27561 (7334)	6158 (1288)						37527 (9829)
Ramrod-R						1710 (438)							1710 (438)
Balan-R	1432 (1255)	512 (544)	402 (352)	22 (39)				781 (1020)	700 (466)	1543 (1948)	1692 (1448)	878 (636)	8062 (7708)
Cobex-R			146 (352)	22 (61)									168 (413)
Trifluralin	3572 (5737)	2174 (3879)	10052 (14393)	6152 (8456)	4132 (6136)	1598 (2754)	528 (732)	41 (82)	18 (36)	2931 (2352)	4248 (5635)	3703 (5470)	39149 (55712)
Diuron	14065 (8550)	961 (1270)	145 (184)	50 (58)	10 (7)	6742 (337)	164 (206)		3 (7)	476 (339)	2158 (1545)	20991 (11503)	45770 (24006)
Linuron			31 (31)		146 (73)								227 (154)
Bromacil	3 (1)		42 (36)	36 (22)						357 (227)	1207 (514)	66 (23)	1711 (823)
Pyrazone	2242 (740)		105 (28)	310 (206)						333 (219)	564 (439)		3654 (1632)
Simazine	2713 (3112)	6534 (7459)	4671 (4967)	142 (127)					12 (7)	2732 (1344)	2695 (1427)	3852 (3795)	23351 (22238)
Dalapon				225 (237)	249 (469)	27 (37)					32 (88)		534 (831)
Dalapon, Sodium Salt	468 (219)	358 (176)	249 (146)	4562 (383)	2881 (676)	159 (37)					191 (88)		8868 (1725)
Sodium TCA	1772 (246)	2817 (392)	126 (28)										4715 (666)
Glyphosate-Isopropylamine Salt					30 (7)	176 (43)				176 (37)			382 (87)
Dacthal-R	10277 (1131)	538 (51)	1116 (161)	5902 (660)	4578 (546)			1649 (219)		7244 (755)	2144 (257)	2977 (313)	36325 (4093)
DNBP	6320 (2895)	2386 (1057)	2836 (2719)	1498 (1000)	2709 (850)	601 (467)	589 (643)	51259 (21281)	68532 (28106)	412 (395)	515 (146)	5484 (2731)	143141 (62590)
Diquat Dibromide								196 (250)	1574 (2949)				1770 (3199)
Paraquat Dichloride	1754 (7284)	11248 (44350)	9774 (32455)	2327 (7902)	784 (1964)	575 (340)	6347 (2080)	5351 (2568)	1524 (8985)	43983 (226683)	4825 (19288)	3771 (12470)	92263 (366869)
Avadex BW-R	201 (161)												201 (161)
Barban	229 (908)	1268 (4888)	331 (1185)									249 (755)	2077 (7736)
CDEC					880 (146)								880 (146)
CIPC					872 (166)						58 (30)	660 (219)	1590 (415)
Eptam-R			923 (264)	820 (235)	2732 (835)	196 (58)		1096 (493)			908 (227)		6675 (2112)
IPC	1319 (294)	1820 (405)		198 (43)				198 (88)				294 (74)	3829 (904)
Tillam-R					9288 (1666)								9288 (1666)
Ordram-R					1836 (617)	475 (195)	542 (180)						2853 (992)
Ro-Neet-R					3522 (812)	121 (56)							3643 (868)
Phenmedipham		96 (67)	2203 (2006)	640 (531)	53 (110)	92 (95)						25 (43)	3109 (2852)
Bromoxynil Octanoate	49 (70)	1376 (3076)	3741 (5688)	311 (531)	16 (22)	53 (73)							5046 (9460)

TABLE D-1. CONTINUED

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
HERBICIDES (Continued)													
Endothall	100 (219)	220 (364)	613 (382)	386 (228)				2433 (1619)	3766 (14484)	7968 (37442)	457 (1916)		15943 (56654)
Planavin-R			414 (414)	118 (118)									532 (532)
N-Sec-Butyl-4-Tert-Butyl-2,6-D		219 (110)											219 (110)
Oryzalin	99 (43)	67 (22)	34 (27)										200 (92)
Profluralin	158 (219)		190 (395)	41 (58)								518 (683)	907 (1355)
Tok-25-R			920 (230)							792 (131)			1712 (361)
Calcium Cyanamide	712 (249)	293 (102)		4577 (1671)								504 (176)	6086 (2198)
Unknown #1929		85 (110)	2117 (3174)	355 (498)									2557 (3782)
SUBTOTAL:	62008 (41436)	77587 (118691)	112547 (156358)	28982 (23400)	44857 (19508)	45277 (13448)	14956 (5501)	64698 (28894)	76939 (55375)	72408 (273742)	25321 (35772)	47350 (42254)	673030 (814379)
FUNGICIDES													
Maneb	27 (32)	3783 (969)	40055 (2344)	1795 (1089)	1107 (545)	1269 (902)	7392 (3134)	860 (533)	2851 (3511)	8164 (7038)	584 (208)		67887 (20305)
Nabam			404 (217)										404 (217)
Zineb	39 (7)	16 (13)	205 (273)	169 (225)	88 (118)								517 (636)
Ziram		1643 (334)											1643 (334)
Topsin-M-R							314 (225)	172 (125)					485 (350)
Benomyl		7426 (10923)	729 (1032)	35 (208)	1248 (2227)	323 (443)	351 (969)	1902 (5252)	209 (689)	387 (161)			13660 (21904)
Botran-R	859 (214)					4221 (2708)	624 (330)	6687 (4142)	1410 (834)	12 (22)			13813 (8250)
Chlorothalonil				67 (43)	756 (505)	27018 (14000)	39524 (19339)	44982 (21524)	1374 (748)	330 (219)			114051 (56378)
Dyrene-R									281 (141)				281 (141)
PCNB			434 (515)	1122 (2343)	1130 (1738)								2686 (4696)
Carboxin							177 (212)	91 (110)					268 (322)
Captan		17875 (4641)	1447 (630)	501 (346)	229 (73)	7882 (2653)	6118 (1562)	23773 (6779)	29664 (11319)	4828 (2282)			92417 (30285)
Difolatan-R				68 (55)		2397 (1437)	16021 (9274)	22072 (11060)	118 (58)				40676 (21884)
Terrazole-R			108 (615)	253 (2116)	146 (904)								507 (3635)
Carbolic Acid		27 (379)			393 (1570)	729 (6105)	1611 (8903)	290 (3074)					3050 (20031)
SUBTOTAL:	925 (253)	30770 (17259)	43382 (5726)	4160 (6425)	5097 (7680)	43839 (28248)	72632 (43948)	100829 (52599)	35907 (17300)	14221 (9722)	584 (208)		352346 (189368)
NEMATOCIDES													
Chloropicrin	1132 (7)		1475 (18)		93 (572)	33220 (331)	3 (1)	23321 (881)		5872 (62)	963 (10)		66079 (1882)
DBCP		301 (19)	5189 (288)	5968 (329)	4297 (209)		100 (43)		532 (31)	12940 (578)	77162 (2400)	33736 (1459)	141325 (5356)

TABLE D-1. CONTINUED

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
NEMATOCIDES (Continued)													
D-D Mixture	533 (2)	15951 (150)	485 (1)			3101 (10)			90062 (464)				110132 (627)
Telone-R										6760 (64)	22129 (127)	68430 (560)	97319 (351)
Ethylene Dibromide	3693 (20)												3693 (20)
Methyl Bromide	9222 (23)		5365 (22)	25861 (103)	4182 (572)	54741 (325)	374 (2)	48522 (900)		13205 (56)	9140 (28)		181612 (2031)
SUBTOTAL:	14580 (52)	16252 (169)	13514 (329)	32829 (432)	8572 (1353)	101062 (666)	477 (46)	71843 (1781)	90694 (495)	38777 (760)	109394 (2565)	102166 (2119)	600160 (10767)
PLANT GROWTH REGULATORS													
Ethephon							1464 (2763)	352 (439)	153 (206)	2 (2)			1971 (3410)
Maleic Hydrazide Diethanolamine Salt							906 (227)						906 (227)
Gibberellins				21 (1418)	51 (3499)	23 (1077)				7 (137)	7 (126)	68 (46)	177 (6303)
SUBTOTAL:				21 (1418)	51 (3499)	23 (1077)	2370 (2990)	352 (439)	153 (206)	9 (139)	7 (125)	68 (46)	3054 (9940)
ADJUVANTS													
Alkylaryl Polyoxyethene Ether						389 (244)							389 (244)
2-Chloro-4-Phenylphenol						31 (535)	138 (258)	257 (689)	28 (340)				454 (2422)
Diethylamine Salt of Coconut	30 (188)	0 (58)		1 (88)	1 (169)	1 (384)	4 (1787)	5 (212)	39 (2213)	1682 (24120)	110 (2787)		1874 (32006)
Ethoxylated Linear Alcohol		23 (106)			28 (121)		204 (277)	7 (186)	80 (298)	250 (888)			592 (1876)
Nonylphenol Polyoxyethylene		2 (58)		4 (88)	4 (169)	7 (384)	33 (1787)	16 (107)	41 (1259)	40 (1204)	1 (23)		148 (5079)
Sodium Xylenesulfonate	22 (188)	0 (58)		1 (88)	38 (400)	71 (850)	219 (3498)	52 (800)	83 (2556)	1693 (25919)	148 (3198)		2327 (38555)
Triethanolamine	38 (188)				48 (231)	59 (466)	275 (1711)	56 (693)	109 (1295)	2685 (25715)	225 (3175)		3535 (33474)
Vinyl Polymer		38 (2293)	298 (3974)		13 (110)	775 (2911)	162 (1260)	11 (270)	940 (3494)	10882 (31668)	334 (1417)	340 (1319)	13843 (48716)
Unknown #1913	15 (188)				19 (231)	34 (466)	108 (1711)	27 (693)	42 (1295)	1053 (25715)	88 (3175)		1387 (33474)
SUBTOTAL:	106 (752)	113 (2573)	298 (3974)	6 (264)	151 (1431)	1397 (6240)	1143 (12989)	442 (3650)	1362 (12750)	18285 (136229)	906 (13775)	340 (1319)	24549 (195246)
DEFOLIANTS													
Cacodylic Acid	21 (188)								308 (3619)	25440 (130773)	204 (1714)		26473 (191294)
DEF									122303 (62991)	161538 (92223)	1604 (717)		285445 (155931)
Folex-R	281 (188)								88440 (43975)	101070 (53974)	1498 (1062)		191289 (99199)
Sodium Cacodylate	125 (188)								4731 (3619)	149156 (130773)	1194 (1714)		155206 (191294)
SUBTOTAL:	427 (564)								216282 (124204)	437204 (507743)	4500 (5207)		658413 (637718)
TOTAL:	92758 (51608)	150693 (157157)	297508 (250280)	173057 (134086)	218871 (136041)	513528 (72840)	666375 (506637)	647530 (477637)	510243 (331394)	632282 (989067)	148870 (52648)	159422 (52115)	4201237 (3545510)

TABLE D-2. 1976 MONTHLY DISTRIBUTION OF SYNTHETIC ORGANIC PESTICIDE PRODUCTS FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.)

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
INSECTICIDES													
Chlordane	4667	3315	4030	3737	3056	3016	3317	2905	1180	2151	2781	3136	37291
Endosulfan					169	1							170
Heptachlor					216	216		197	129	145	123	100	1126
Diazinon	279	799	231	284	255	623	528	229	439	170	155	214	4206
Dursban-R	61	22	175	126	37	130	91	349	161	310	298	120	1930
Fenthion					29	76	38	35	3	1			182
Malathion	254	544	809	5118	613	869	462	603	453	16776	942	394	27837
Methyl Parathion							23	79	125	284			511
Naled					29			260	209	271			769
Parathion			117	281	585	1347	1737	2027					6094
Phorate		828	1638										2466
Baygon-R					85	290	620	1055	568	283			2901
Carbaryl	78			11	128	224	190	154	43	170	40	2	1040
Omite					14	42	67	29	1				153
Amines, Aliphatic			12	29	42	12	12	443	27	29	17		623
Carbon Tetra-chloride											190	379	569
Carbon Disulfide	139	32		14						45			230
Ethylene Dichlor-ide											443	887	1330
SUBTOTAL:	5478	5540	7012	9600	5308	6846	7085	8365	3338	20635	4989	5232	89428
HERBICIDES													
DSMA								36	1698	215	31		1980
MSMA			635	181	78	246	172	29		14			1355
MCPA, Isooctyl Ester							99		17	17			133
2,4-D Amine Salt					8					1481	359		1848
4(2,4-DB), Butoxy-ethanol Ester								74		29			103
Diuron		6	201	88	48				98	1883	1269		3593
Monuron				1173									1173
Amitrole	121	6	19	107	14	10	25	6	6	366	420	40	1140
Atrazine	779	516	226							17	483	354	2375
Bromacil	83	117	77	17					299	360	1988		2941
Prometone-R	18	742		87				55	11	6	33		952
Simazine	664	726	34	156	25	93	13	570	174	394	1178	478	4505
Dalapon, Sodium Salt				42		70				11			123
Sodium TCA						39				5810			5849
Glyphosate, Isopro-pylamine Salt	6	18		82	1398	895	311	1505	374	224	96		4909
Fenac			45							90	877		1012
2,3,6-TBA Dimethyl-amine Salt									428	77	77		582
Dichlobenil				146	23			37	8	38	42		294
Diphenamid	118		146	37	41		575	48		23		82	1070
Bromoxynil Octanoate			12	25	197	594	219	803	111	21	23		2005
1-(5-Tert-Butyl-1,2,4-Thiadiaz)	405	1249	6	4					68	152	1808	12	3704
SUBTOTAL:	2194	3380	1401	2145	1832	1947	1414	3163	3292	11228	3684	966	41646

TABLE D-2. CONTINUED

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
FUNGICIDES													
Benomyl		12	69	182	146	131	12	100	52	55	135		894
Sotran-R					127				190				317
Dowcide-A-R	809		1059	1062	573	1731	647	647	1259	405	1084		9276
PCNB			303										303
Captan			303						64				367
Thiabendazole-R	16		130	1	1	36							184
Sec-Butylamine	2198		1319		989				330	880	2529		8245
SUBTOTAL:	3023	12	3183	1245	1836	1898	659	747	1895	1340	3748		19586
NEMATOCIDES													
Methyl Bromide	7530	11161	5114	4643	4776	3665	4444	2822	5837	10385	13243	4299	77919
SUBTOTAL:	7530	11161	5114	4643	4776	3665	4444	2822	5837	10385	13243	4299	77919
PLANT GROWTH REGULATORS													
Maleic Hydrazide Diethanolamine Salt				12752	76133								88885
SUBTOTAL:				12752	76133								88885
DEFOLIANTS													
Cacodylic Acid	11	25	66	55	1	6	216	6	289	37	4	22	738
Sodium Cacodylate	59	146	382	318	6	37	1262			3		133	2346
SUBTOTAL:	70	171	448	373	7	43	1478	6	289	40	4	155	3084
TOTAL:	18295	20264	17158	30758	89892	14399	15080	15103	14651	43628	30663	10652	320548

TABLE D-3. 1976 MONTHLY DISTRIBUTION OF INORGANIC PESTICIDES FOR APPLICATION IN FRESNO COUNTY (LBS.)

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Ammate					175	501	835						1511
Blue Vitriol	2326	6555				690	139		295		4422	12029	30858
Borax	271												271
Calcium Chloride						137							137
COCS	194	9049										395	9638
Copper	513	523						11		2336	364	88	3835
Copper Hydroxide	1047	10528			234				1769		121	235	13934
Copper Oxide	323												323
Copper Oxychloride Sulfate	1037	753	155	33	71	139	86	139	1017	10687	3076	1822	19019
Copper Salts			690	3219									3909
Copper Sulfate	24523	38923	61						117	6487	5089	10594	85794
Copper-Zinc Sulfate Complex	1240	5614	393			1976		11148	15774	15080	1342	2873	55440
Cryolite				2318	167553	250459	122585	9277	3485				560677
Diammonium Phosphate	1	19	224	315	817	396	678	542	325	375		328	4020
Disodium Octaborate Tetrahydra	427										1229	536	2192
Lead Arsenate					1068								1068
Lignin Sulfonic Acid		43	500	2102	685	146	152	157	99	234			4117
Lye	739		1267	739	423	527	739	344	106	211	527		6122
Magnesium Sulfate				57	195	83							335
Phosphorous		148		190									338
Phostoxin-R		67	55	25	18	130		230	1		81	18	625
Sec-Butylammonium Phosphate	3560		2348		5530	2727	1363				1515		17043
Sodium Arsenite	1487	4900	1200										7535
Sodium Chlorate	1818	2213	4	330				1662	29856	670136	4604	182	710811
Sodium Metaborate	3704	4898	6	731									9339
Sulfur		2408	10332	174062	1117481	2083993	815769	598775	86773	17246			4906839
Sulfuric Acid				106483									106483
Vikane-R		32	51	96	32	157	43	34	71	107	205	90	918
Zinc Phosphide	30	34	18	35	1	2		45					165
Zinc Sulfate	1	46	25	197	1755	3759	6183	3558	146	298	10		15978
TOTAL:	43241	86709	17333	290931	1296036	2345822	948572	626422	144834	727619	22565	29190	6579274

TABLE D-4. 1976 MONTHLY DISTRIBUTION OF INERT ORGANIC INGREDIENTS (FORMULATION CODE 04) FOR ACREAGE APPLICATION IN FRESNO COUNTY. THE UPPER NUMBER IS LBS.; THE LOWER NUMBER IN () IS ACREAGE.

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Distillate	2283 (6447)	2536 (7163)	19276 (54441)	9638 (27220)	16207 (45773)	29904 (84455)	50144 (141617)	39111 (110457)	33683 (95128)	39237 (110815)	6772 (19125)	4565 (12894)	253356 (715536)
Emulsifiers	1382 (3902)	1535 (4336)	11667 (32950)	5833 (16475)	9809 (27704)	18099 (51116)	30349 (85714)	23671 (66854)	20386 (57576)	23748 (67071)	4099 (11576)	2763 (7804)	153341 (433078)
Methyl Oleate	1162 (3282)	1291 (3646)	9815 (27713)	4908 (13856)	8252 (23301)	15226 (42991)	25532 (72090)	19914 (56228)	17151 (48425)	19979 (56410)	3448 (9736)	2325 (6564)	129003 (364242)
Kerosene	1129 (3187)	1254 (3541)	9530 (25915)	4765 (13458)	8013 (22630)	14785 (41754)	24792 (70014)	19337 (54609)	16653 (47030)	19399 (54786)	3348 (9456)	2257 (6375)	125262 (353755)
Xylene	192 (543)	214 (603)	1623 (4583)	812 (2340)	1365 (3854)	2518 (7110)	4222 (11923)	3293 (9300)	2836 (8009)	3304 (9330)	570 (1610)	384 (1086)	21333 (60291)
Cyclohexanone	137 (387)	152 (429)	1158 (3254)	579 (1632)	973 (2744)	1796 (5064)	3012 (8490)	2349 (6622)	2023 (5703)	2357 (6644)	407 (1147)	274 (774)	15217 (42900)
Technical Inerts	81 (229)	90 (254)	685 (1933)	342 (967)	576 (1626)	1062 (2999)	1781 (5030)	1389 (3923)	1196 (3378)	1394 (3936)	241 (679)	162 (458)	8999 (25412)
Butyrolactone	36 (103)	40 (114)	307 (869)	154 (434)	260 (730)	477 (1348)	801 (2260)	624 (1762)	537 (1513)	626 (1768)	108 (305)	73 (206)	4043 (11417)
Isopropanol	12 (33)	13 (37)	99 (280)	50 (140)	83 (235)	154 (434)	258 (728)	201 (568)	173 (489)	202 (570)	35 (98)	23 (66)	1303 (3678)
Butyl Mercaptan	7 (20)	8 (22)	59 (167)	30 (83)	50 (140)	92 (258)	154 (433)	120 (338)	103 (291)	120 (339)	21 (59)	14 (39)	778 (2189)
Epichlorohycrin	7 (19)	8 (22)	58 (164)	29 (82)	49 (138)	91 (255)	152 (428)	118 (334)	102 (287)	119 (335)	20 (58)	14 (39)	767 (2161)
Dibutyl Disulfide	3 (8)	3 (9)	23 (67)	12 (33)	20 (56)	36 (104)	61 (174)	48 (135)	41 (117)	48 (136)	8 (23)	6 (16)	309 (878)
Isofuron	2 (6)	2 (6)	17 (48)	9 (24)	14 (41)	26 (75)	44 (125)	35 (98)	30 (84)	35 (98)	6 (17)	4 (11)	224 (633)
Benzene	1 (4)	1 (4)	11 (32)	6 (16)	10 (27)	18 (49)	29 (83)	23 (65)	20 (56)	21 (65)	4 (11)	3 (8)	147 (420)
Methyl Isobutyl Ketone	0 (1)	0 (1)	2 (6)	1 (3)	2 (5)	3 (9)	5 (15)	4 (12)	4 (10)	4 (12)	1 (2)	1 (1)	28 (78)
TOTAL:	6434 (18171)	7147 (20187)	54330 (153432)	27168 (76763)	45683 (129004)	34207 (238021)	141337 (399124)	110237 (311305)	94938 (268101)	110593 (312315)	19088 (53903)	12868 (36341)	714110 (2016668)

TABLE D-5. 1976 MONTHLY DISTRIBUTION OF INERT ORGANIC INGREDIENTS (FORMULATION CODE 04) FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.)

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Distillate	322	202	1199	623	996	1820	3019	2365	2023	2240	451	300	15560
Emulsifiers	201	122	725	377	603	1102	1827	1432	1223	1356	273	175	9416
Methyl Oleate	170	104	610	318	506	928	1533	1204	1029	1141	230	146	7924
Kerosene	154	102	593	308	493	901	1492	1170	999	1107	223	154	7696
Xylene	30	18	100	57	84	153	253	197	169	188	38	22	1309
Cyclohexanone	20	11	72	37	59	109	182	142	122	135	27	18	934
Technical Inerts	12	7	43	22	33	65	108	85	72	80	17	10	554
Butyrolactone	5	3	19	10	16	29	48	38	32	36	7	5	248
Isopropanol	2	1	5	3	5	9	15	12	10	12	2	2	79
Butyl Mercaptan	1	1	4	2	3	5	9	7	6	7	1	1	47
Hexane	1	1	4	2	3	5	9	7	6	7	1	1	47
Epichlorohydrin	1	1	4	2	3	9	9	7	6	7	1	1	51
Dibutyl Disulfide	0	0	1	1	1	2	4	3	2	3	1	0	18
Isofuron	0	0	1	1	1	2	3	2	2	2	0	0	14
Benzene	0	0	1	0	1	1	2	1	1	1	0		8
Methyl Isobutyl Ketone			0	0	0	0	0	0	0	0	0		0
TOTAL:	919	573	3382	1763	2807	5140	8518	6672	5703	6322	1272	835	42905

TABLE D-6. 1976 MONTHLY DISTRIBUTION OF INERT ORGANIC INGREDIENTS (FORMULATION CODE 09) FOR ACREAGE APPLICATION IN FRESNO COUNTY. THE UPPER NUMBER IS LBS.; THE LOWER NUMBER IN () IS ACREAGE.

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Methyl Isobutyl Ketone	632 (7486)	2419 (28632)	3797 (44794)	1657 (19624)	4073 (48244)	2967 (35150)	6074 (71953)	9457 (112927)	7180 (85047)	25885 (306622)	2417 (28632)	2485 (29435)	69043 (817826)
Butyrolactone	459 (5431)	1782 (21112)	2802 (33190)	1224 (14499)	3005 (35599)	2192 (25964)	4484 (53109)	6978 (82663)	5297 (62743)	19103 (226285)	1782 (21112)	1835 (21737)	50943 (603444)
Emulsifier	435 (5148)	1693 (20048)	2660 (31513)	1160 (13744)	2853 (33793)	2080 (24641)	4254 (50393)	6625 (78471)	5030 (59579)	18133 (214797)	1693 (20048)	1740 (20615)	48356 (572790)
Dupanol	216 (2562)	841 (9965)	1322 (15656)	576 (6825)	1419 (16814)	1033 (12232)	2115 (25055)	3305 (39152)	2500 (29612)	9015 (106785)	841 (9965)	865 (10249)	24048 (284872)
Propylene Glycol	201 (2385)	783 (9280)	1232 (14594)	537 (6364)	1322 (15656)	965 (11429)	1973 (23366)	3071 (36378)	2331 (27617)	8404 (99547)	783 (9280)	806 (9552)	22408 (265448)
Diesel Oil	193 (2291)	751 (8891)	1180 (13980)	515 (6104)	1266 (14996)	922 (10922)	1888 (22363)	2940 (34831)	2233 (26448)	8048 (95332)	751 (8891)	773 (9150)	21460 (254199)
Xylene	63 (744)	244 (2893)	384 (4545)	167 (1984)	412 (4876)	300 (3554)	615 (7285)	958 (11346)	726 (8595)	2621 (31042)	244 (2893)	251 (2975)	6985 (82732)
Methyl Cellosolve	60 (709)	234 (2775)	367 (4345)	159 (1889)	394 (4664)	288 (3412)	588 (6916)	915 (10839)	695 (8229)	2506 (29683)	232 (2751)	240 (2846)	6678 (79108)
Technical Inerts	44 (519)	166 (1972)	260 (3082)	113 (1335)	279 (3306)	204 (2420)	418 (4947)	650 (7698)	493 (5844)	1778 (21064)	166 (1972)	170 (2019)	4741 (56178)
Isopropanol	35 (414)	139 (1642)	216 (2562)	95 (1121)	232 (2751)	169 (2008)	346 (4097)	538 (6376)	410 (4852)	1476 (17486)	139 (1642)	140 (1653)	3935 (46604)
Toluene	12 (142)	49 (578)	78 (921)	343 (4062)	85 (1004)	62 (732)	125 (1476)	195 (2315)	149 (1759)	534 (6329)	49 (578)	50 (590)	1731 (20486)
Paraffin	10 (118)	43 (507)	66 (779)	28 (331)	71 (838)	52 (614)	105 (1240)	164 (1948)	125 (1476)	450 (5325)	43 (507)	44 (519)	1201 (14202)
Ethylene Glycol	4 (47)	18 (212)	27 (319)	12 (142)	30 (354)	22 (260)	44 (519)	69 (814)	52 (614)	189 (2232)	18 (212)	18 (212)	503 (5937)
Diethylene Triamine	4 (47)	13 (154)	21 (248)	10 (118)	22 (260)	16 (189)	33 (390)	51 (602)	39 (461)	138 (1642)	13 (154)	13 (154)	373 (4419)
Cyclohexanol	1 (12)	6 (71)	11 (130)	4 (47)	11 (130)	7 (83)	16 (189)	25 (295)	20 (236)	69 (814)	8 (95)	5 (71)	184 (2173)
TOTAL:	2369 (28055)	9181 (108732)	14423 (170838)	6600 (78189)	15474 (133610)	11279 (133610)	23078 (273348)	35941 (425755)	27280 (323112)	98349 (1164985)	9179 (108732)	9436 (111777)	262589 (3110418)

TABLE D-7. 1976 MONTHLY DISTRIBUTION OF INERT ORGANIC INGREDIENTS (FORMULATION CODE 09) FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.)

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Methyl Isobutyl Ketone	111	19	205	355	1317	158	121	1310	151	373	170	29	4319
Butyrolactone	82	14	151	262	972	117	89	967	111	275	125	22	3188
Emulsifier	77	13	144	249	922	111	85	918	106	261	119	21	3026
Dupanol	39	6	71	124	459	55	42	457	53	130	59	10	1505
Propylene Glycol	36	6	67	115	428	51	39	426	49	121	55	10	1403
Diesel Oil	34	6	64	111	410	49	38	408	47	116	53	9	1345
Xylene	4	15	24	10	26	19	39	60	45	160	15	15	432
Methyl Cellosolve	4	14	23	10	24	18	37	58	43	152	14	14	411
Technical Inerts	3	10	15	7	18	12	26	42	31	110	10	10	294
Isopropanol	2	8	13	6	14	10	21	34	25	94	8	8	243
Toluene	1	3	5	21	5	4	8	12	9	35	3	3	109
Paraffin	1	2	4	2	4	3	6	10	8	29	2	3	74
Ethylene Glycol		1	2	1	2	1	3	4	3	11	1	1	30
Diethylene Triamine		1	1	1	1	1	2	3	2	8	1	1	22
Cyclonexanol			1		1		1	1	1	4			9
TOTAL:	394	118	790	1274	4603	609	557	4710	684	1879	636	156	16410

TABLE D-8. 1976 MONTHLY DISTRIBUTION OF NONSYNTHETIC PRODUCTS (AS MINOR ACTIVE INGREDIENTS) FOR ACREAGE APPLICATION IN FRESNO COUNTY. THE UPPER NUMBER IS LBS.; THE LOWER NUMBER IN () IS ACREAGE.

CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Solvent	3 (6)	65 (52)	15128 (12073)	7382 (6290)	25419 (20285)	14692 (11709)	46057 (36755)	56216 (44861)	7325 (6244)	2200 (1756)	5 (3)	151163 (852)	326640 (140886)
Petroleum Distillate	159 (127)	2746 (2191)	18296 (14601)	381 (304)	43 (35)	3381 (2699)	4228 (3374)	3637 (2902)	1508 (1203)			1164 (929)	35543 (28365)
Petroleum Distillate, Aromatic			14 (12)	5561 (4438)	844 (674)	800 (639)	2771 (2212)	4420 (3528)	2060 (1644)		30 (23)	170 (136)	16670 (13306)
Petroleum Hydrocarbon	223 (178)	2578 (2057)	2912 (2325)	4543 (3625)	2873 (2293)	7327 (5847)	12822 (10232)	12383 (9881)	19293 (15396)	24543 (19586)	2248 (1795)	2546 (2113)	94391 (75328)
Petroleum Oil, Unclassified	49326 (2169)	123166 (6259)	8495 (511)	108 (571)	16720 (634)	6306 (155)	6508 (105)	7274 (312)	10677 (4559)	11344 (10365)	1584 (114)	93470 (2543)	334978 (28297)
Xylene	638 (510)	1337 (1066)	3006 (2399)	5843 (4663)	8312 (6633)	14058 (11218)	27208 (21713)	21277 (16980)	8533 (6810)	5786 (4617)	822 (656)	347 (277)	97167 (77542)
Xylene Range Aromatic Solvent		139 (112)	453 (361)	261 (208)	1367 (1091)	12421 (9912)	20305 (16203)	9725 (7760)	3455 (2757)	1502 (1200)		3 (2)	49631 (39606)
TOTAL:	50354 (2990)	130031 (11737)	48304 (32282)	24579 (20099)	55578 (31645)	58965 (42179)	119899 (90594)	114932 (86224)	53361 (38613)	45375 (37524)	4688 (2591)	248964 (6852)	955020 (403330)

TABLE D-9. 1976 MONTHLY DISTRIBUTION OF NONSYNTHETIC PRODUCTS (AS MINOR ACTIVE INGREDIENTS) FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.)

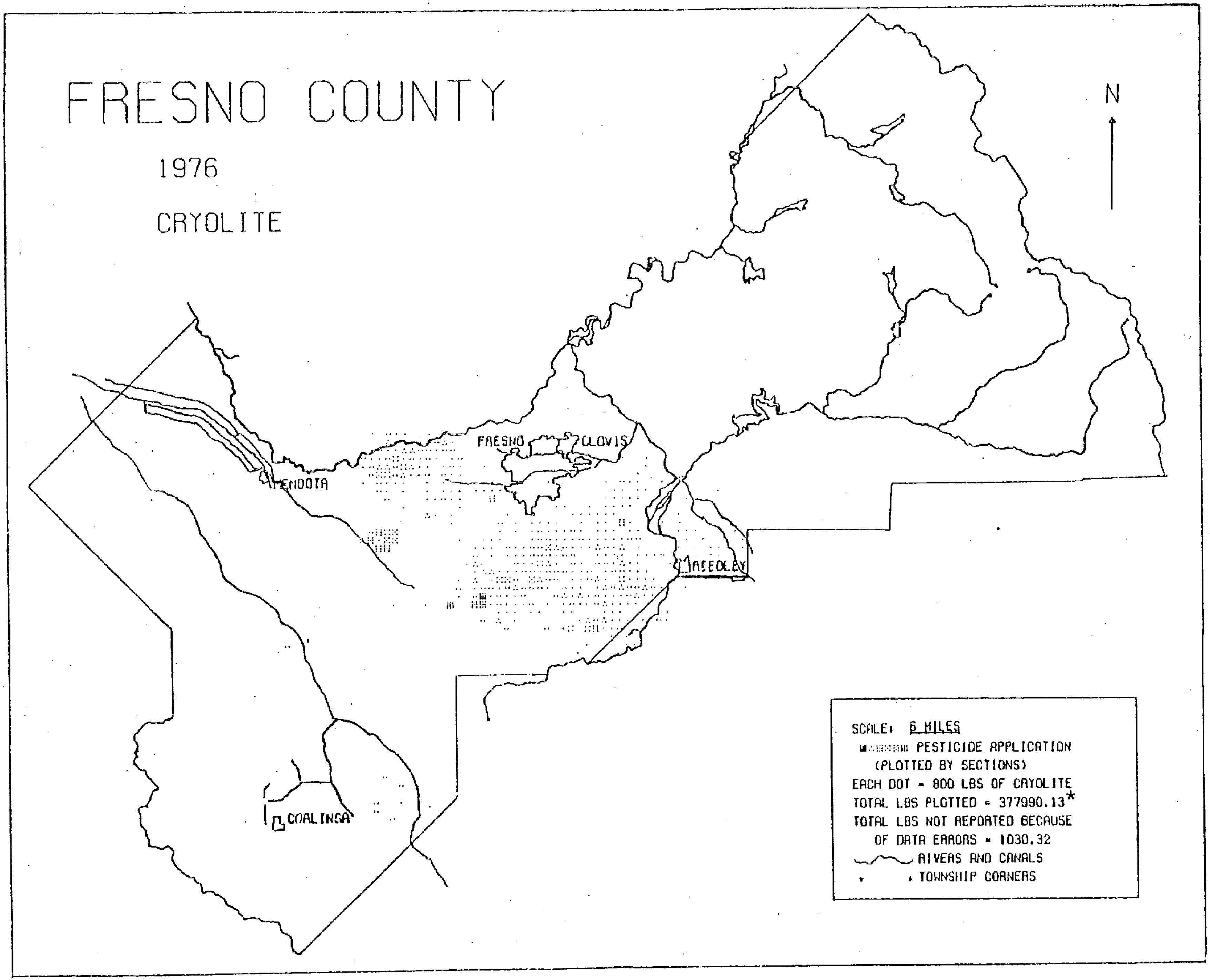
CHEMICALS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Solvent	437	461	392	389	502	1003	514	1178	811	1031	1358	329	9005
Mineral Oil	27	672	33	918	145	57	47	41					
Petroleum Distillate	1370	739	6625	6674	9954	3692	3620	89113	6036	6698	4731	1688	140940
Petroleum Hydrocarbon	18	30	10	52	76353	8	5	38	13896	29	10	55	90504
Petroleum Oil, Unclassified	2326	3112	1152	432	23	209	311	179	26	2098	300	3640	13808
Xylene	103	271	305	348	297	208	142	182	31	147	16		2090
Xylene Range Aromatic Solvent									184	207	120	116	627
TOTAL:	4281	5295	8517	8813	87264	5177	4739	90731	21034	10210	6535	5328	258914

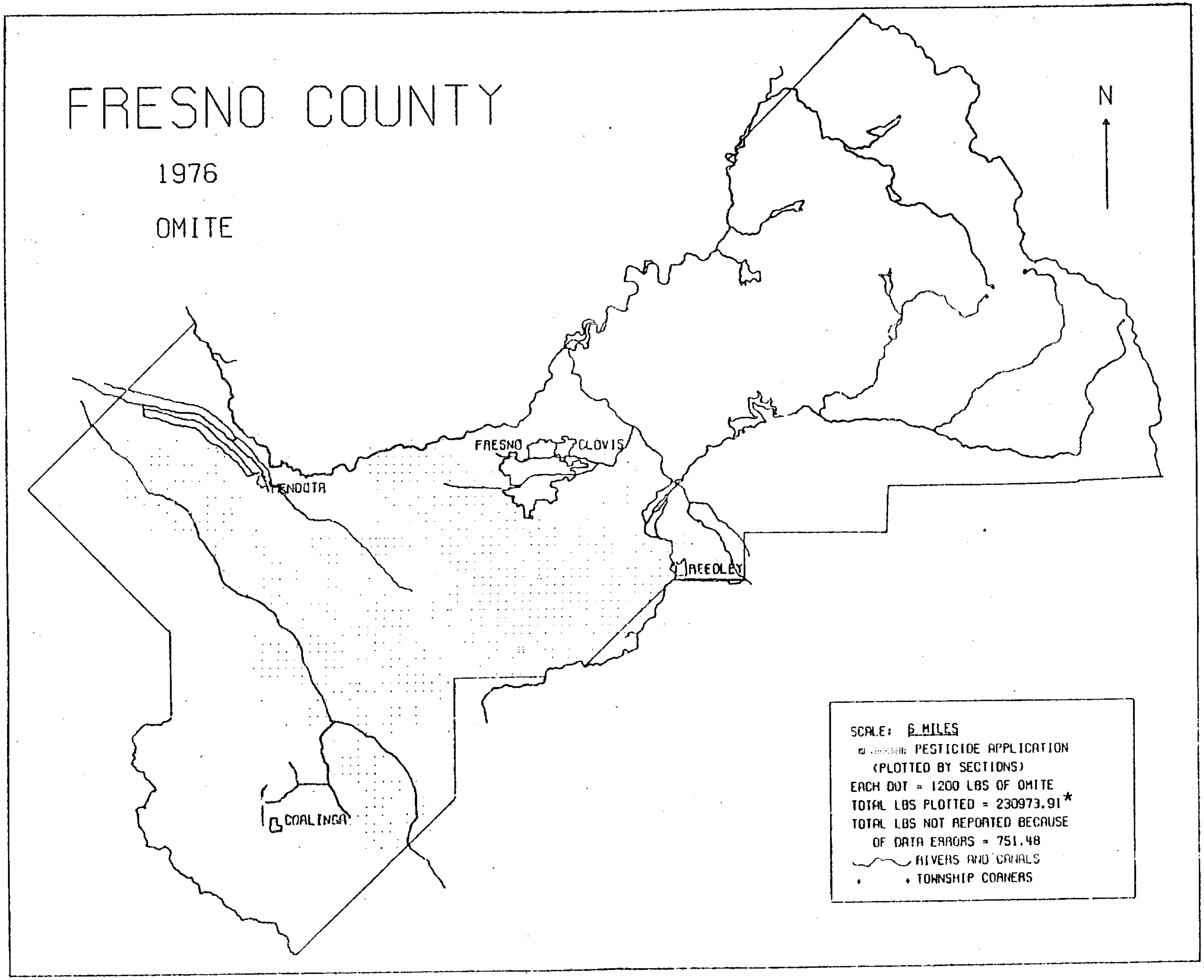
TABLE D-10. 1976 MONTHLY DISTRIBUTION OF NONSYNTHETIC PRODUCTS (AS PURE OIL) FOR ACREAGE APPLICATION IN FRESNO COUNTY. MONTHLY DISTRIBUTIONS OF PETROLEUM PRODUCTS ARE BASED ON DISTRIBUTION RATIOS REPORTED IN PUR; THE MONTHLY ACREAGE IS BASED ON ANNUAL APPLICATION RATE. THE UPPER NUMBER IS LBS.; THE LOWER NUMBER IN () IS ACREAGE.

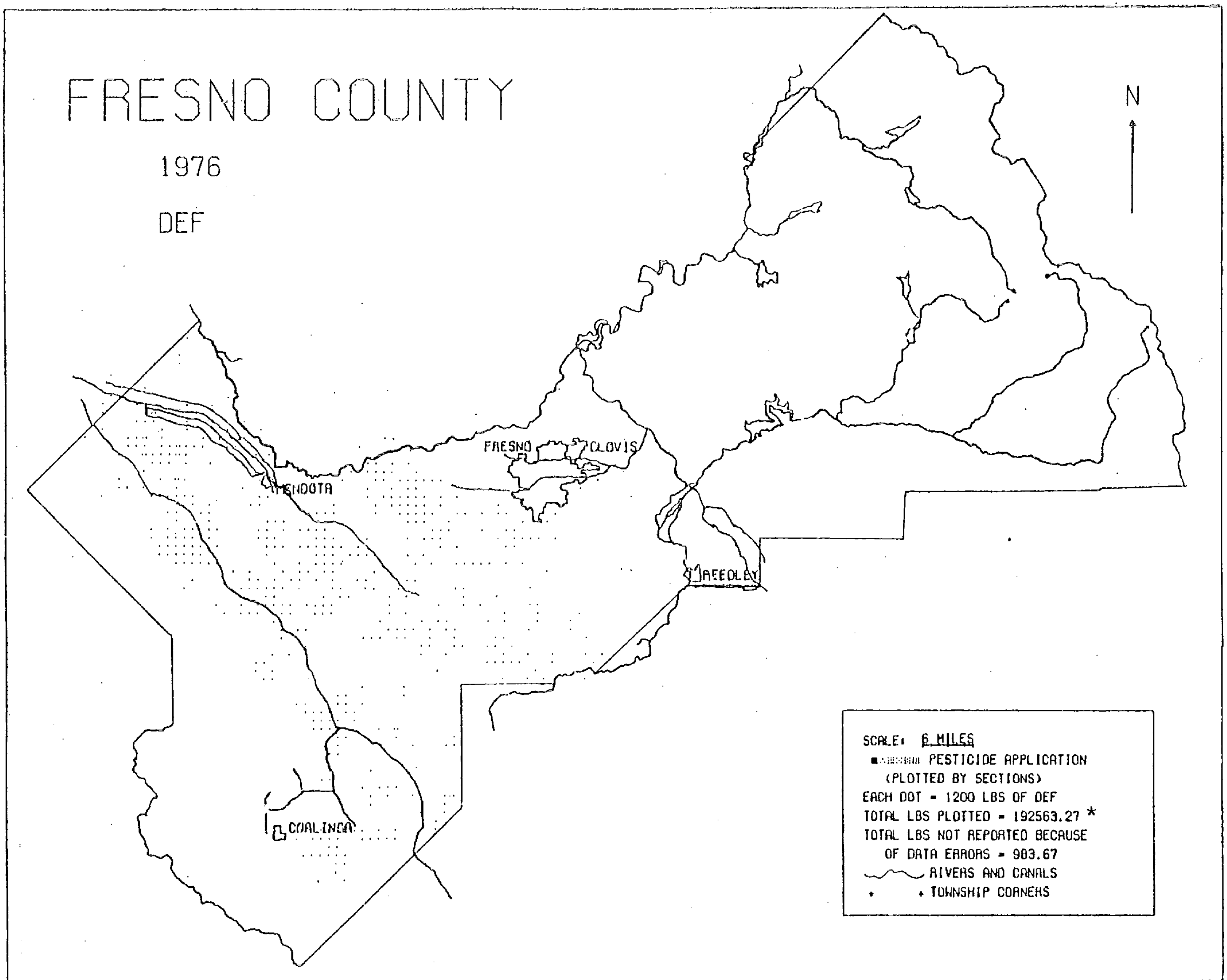
PESTICIDE PRODUCTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Solvent												1692127	1692127
Mineral Oil	30215 (10334)	245036 (83807)	18887 (6459)		7213 (2468)		9305 (3222)						310656 (106290)
Petroleum Distillates								1951 (668)					1951 (668)
Petroleum Hydrocarbons					695352 (237824)			1186035 (405648)	103789 (35498)				1985176 (678970)
Petroleum Oil, Unclassified	417678 (142854)	1085062 (371115)	35404 (12109)	6786 (2321)	152507 (52160)	40718 (13926)	24622 (8421)	67377 (23044)	38723 (13245)	27145 (9284)	20359 (6963)	879875 (300936)	2796256 (956378)
<u>TOTAL:</u>	447894 (153188)	1330099 (454922)	54290 (18568)	6786 (2321)	855071 (292452)	40718 (13926)	33927 (11643)	1255363 (429360)	142512 (48743)	27145 (9284)	1712486 (585705)	879875 (300936)	6786166 (2321048)

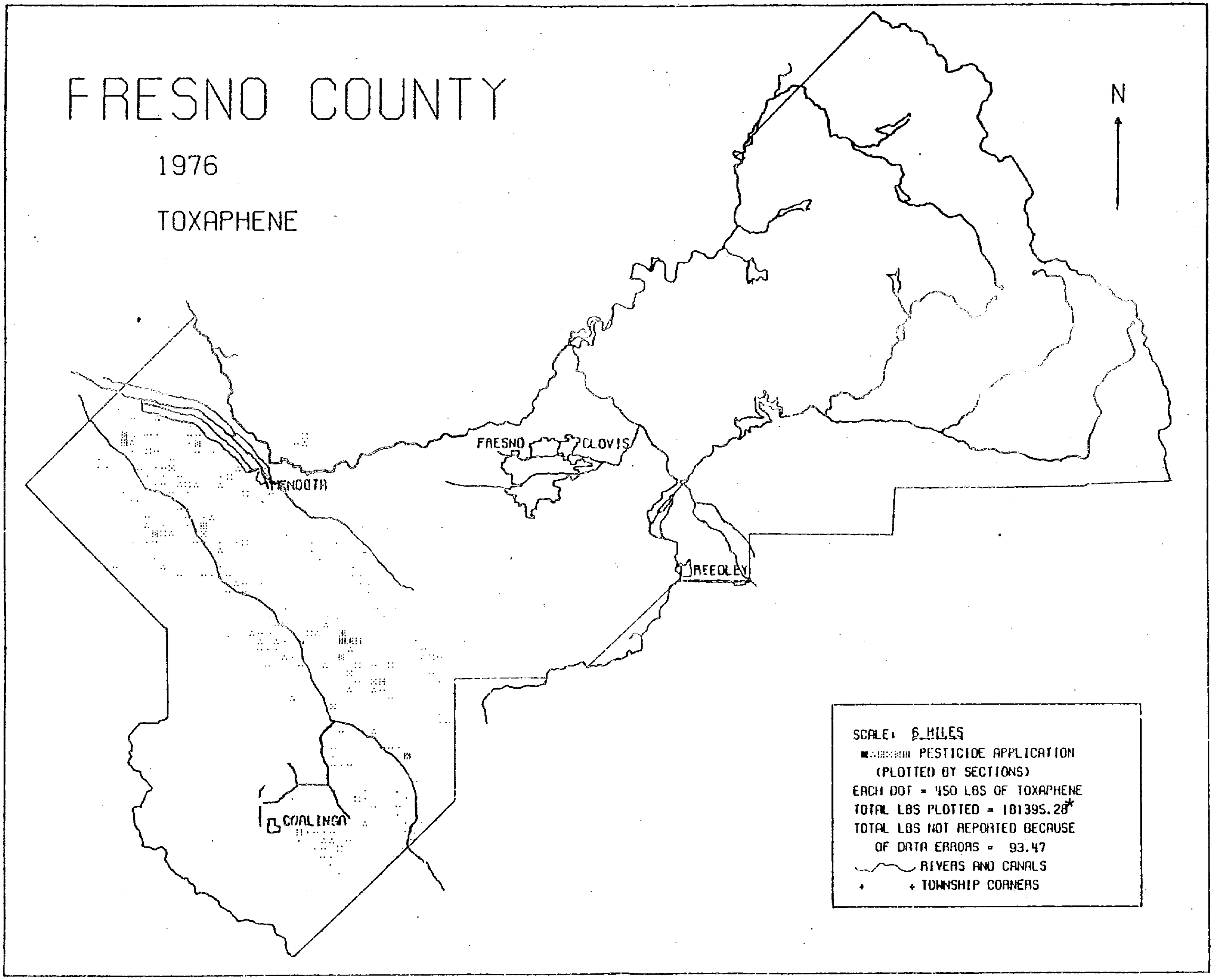
TABLE D-11. 1976 MONTHLY DISTRIBUTION OF NONSYNTHETIC PRODUCTS (AS PURE OIL) FOR NONACREAGE APPLICATION IN FRESNO COUNTY. MONTHLY DISTRIBUTIONS OF PETROLEUM PRODUCTS ARE BASED ON DISTRIBUTION RATIOS REPORTED IN PUR. (LBS.)

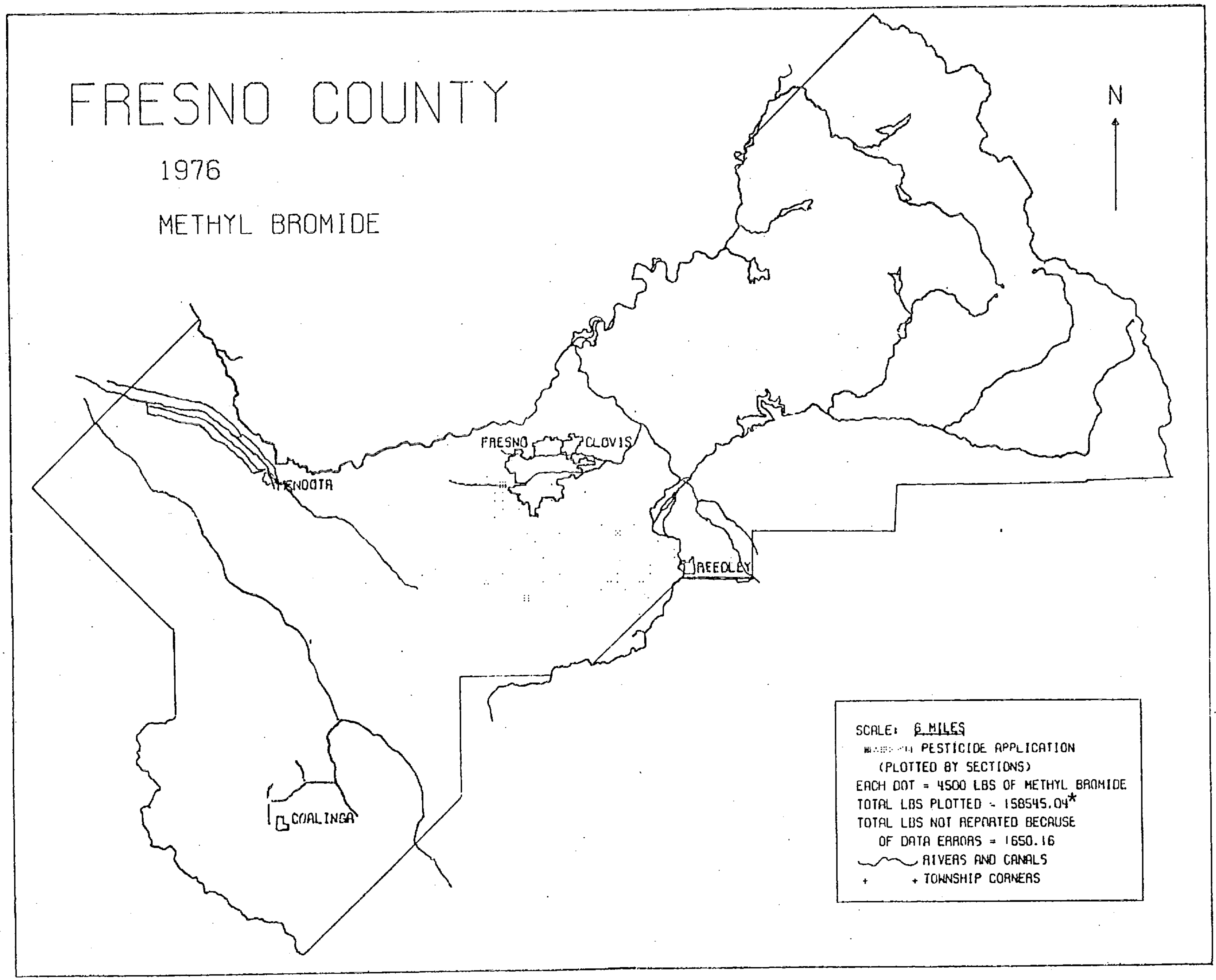
PESTICIDE PRODUCTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Solvent											476238		476238
Mineral Oil	8504	66299	5315		2031		2619						476238
Petroleum Distillates								549					549
Petroleum Hydrocarbon					195701			343371	29211				568282
Petroleum Oil, Unclassified	117554	298507	9964	1910	42923	11460	6930	18962	10898	7639	5730	247635	780113
<u>TOTAL:</u>	126058	364806	15279	1910	240655	11460	9549	362882	40109	7639	481968	247635	1909951

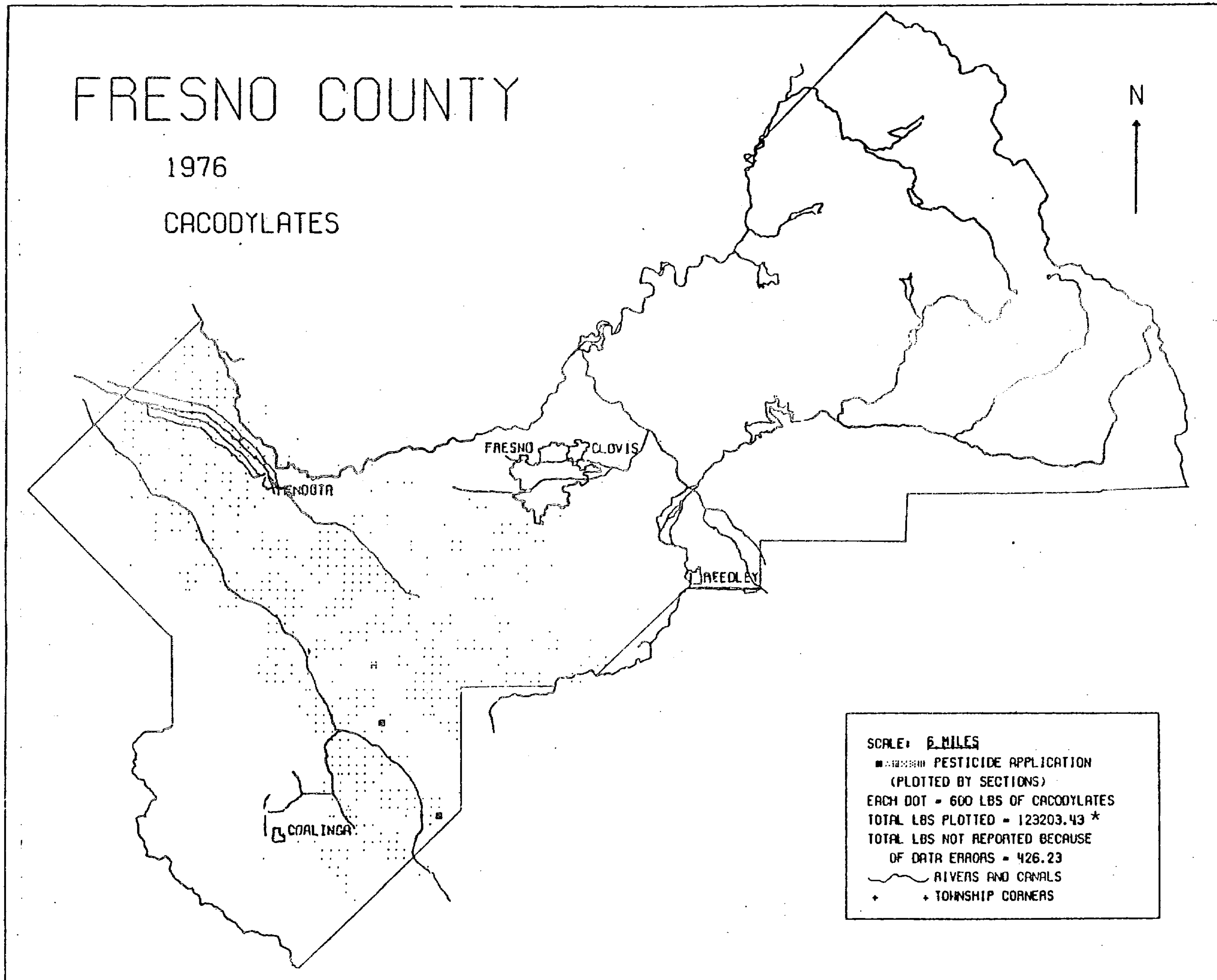

FRESNO COUNTY
1976
CRYOLITE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 800 LBS OF CRYOLITE
TOTAL LBS PLOTTED = 377990.13*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 1030.32
RIVERS AND CANALS
TOWNSHIP CORNERS

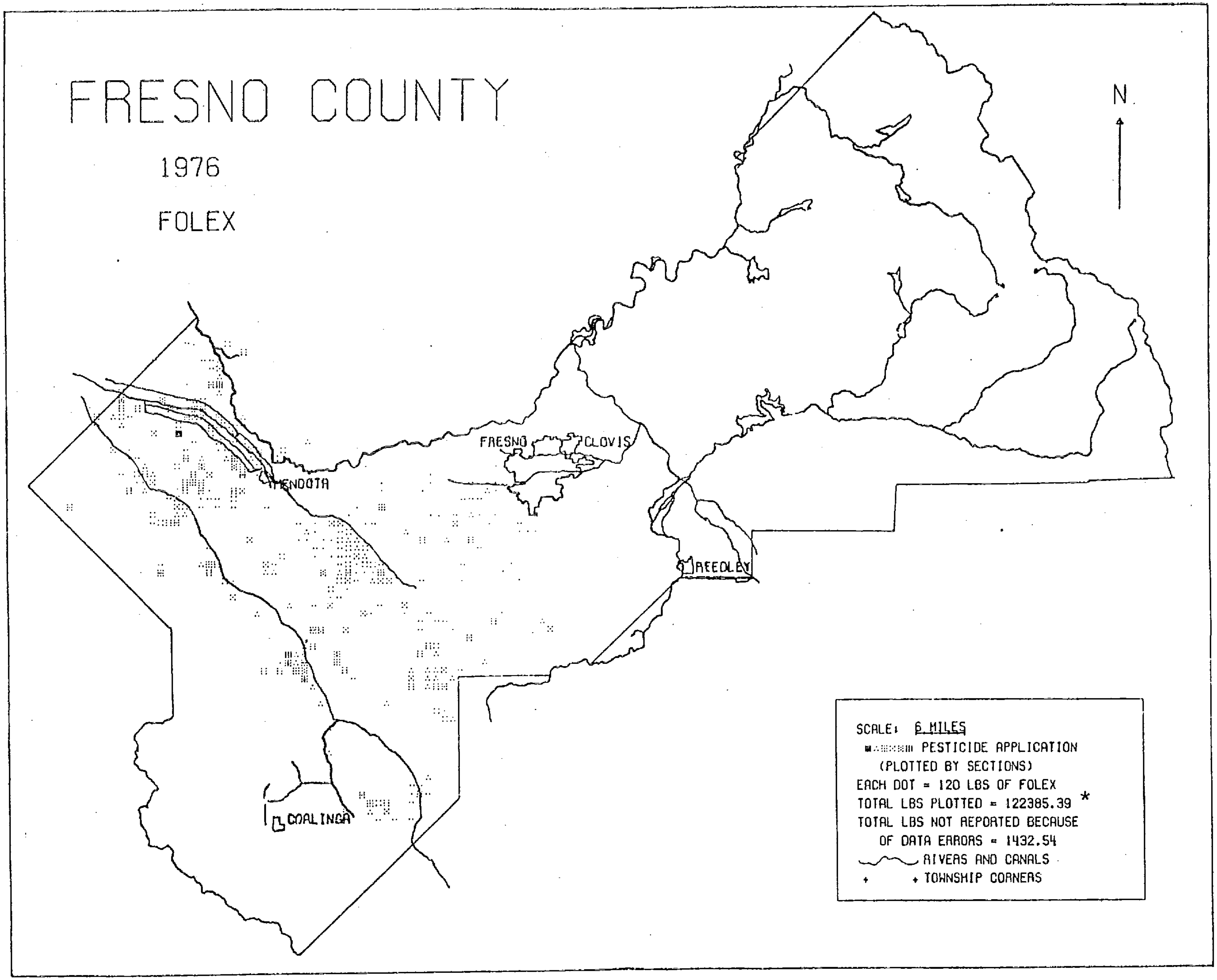

FRESNO COUNTY
1976
OMITE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 1200 LBS OF OMITE
TOTAL LBS PLOTTED = 230973.91*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 751.48
RIVERS AND CANALS
TOWNSHIP CORNERS

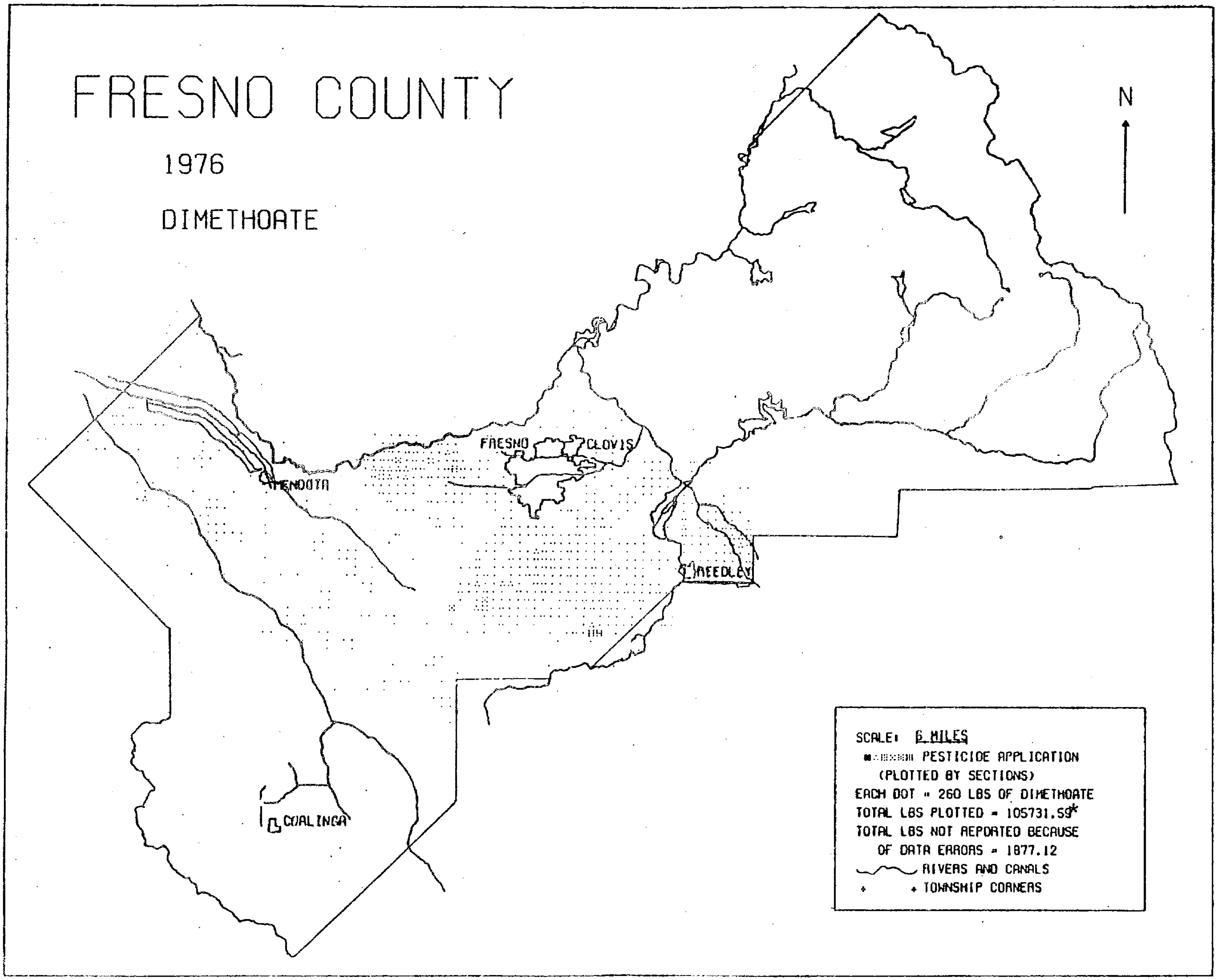

FRESNO COUNTY
1976
DEF
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 1200 LBS OF DEF
TOTAL LBS PLOTTED = 192563.27 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 903.67
RIVERS AND CANALS
+ TOWNSHIP CORNERS

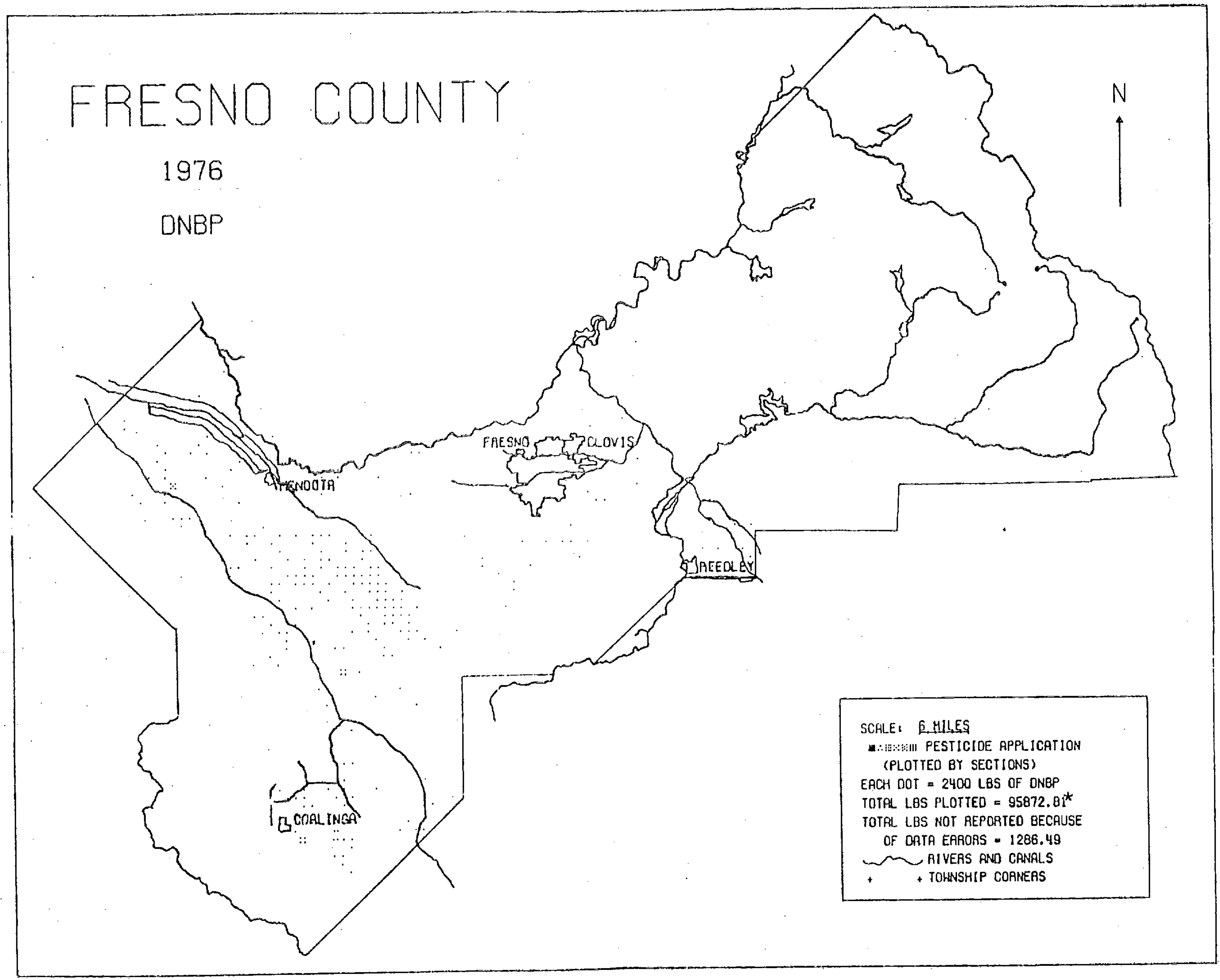

FRESNO COUNTY
1976
TOXAPHENE
N
FRESNO
CLOVIS
REEDLEY
MENDOTA
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 450 LBS OF TOXAPHENE
TOTAL LBS PLOTTED = 101395.28*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 93.47
RIVERS AND CANALS
+ TOWNSHIP CORNERS

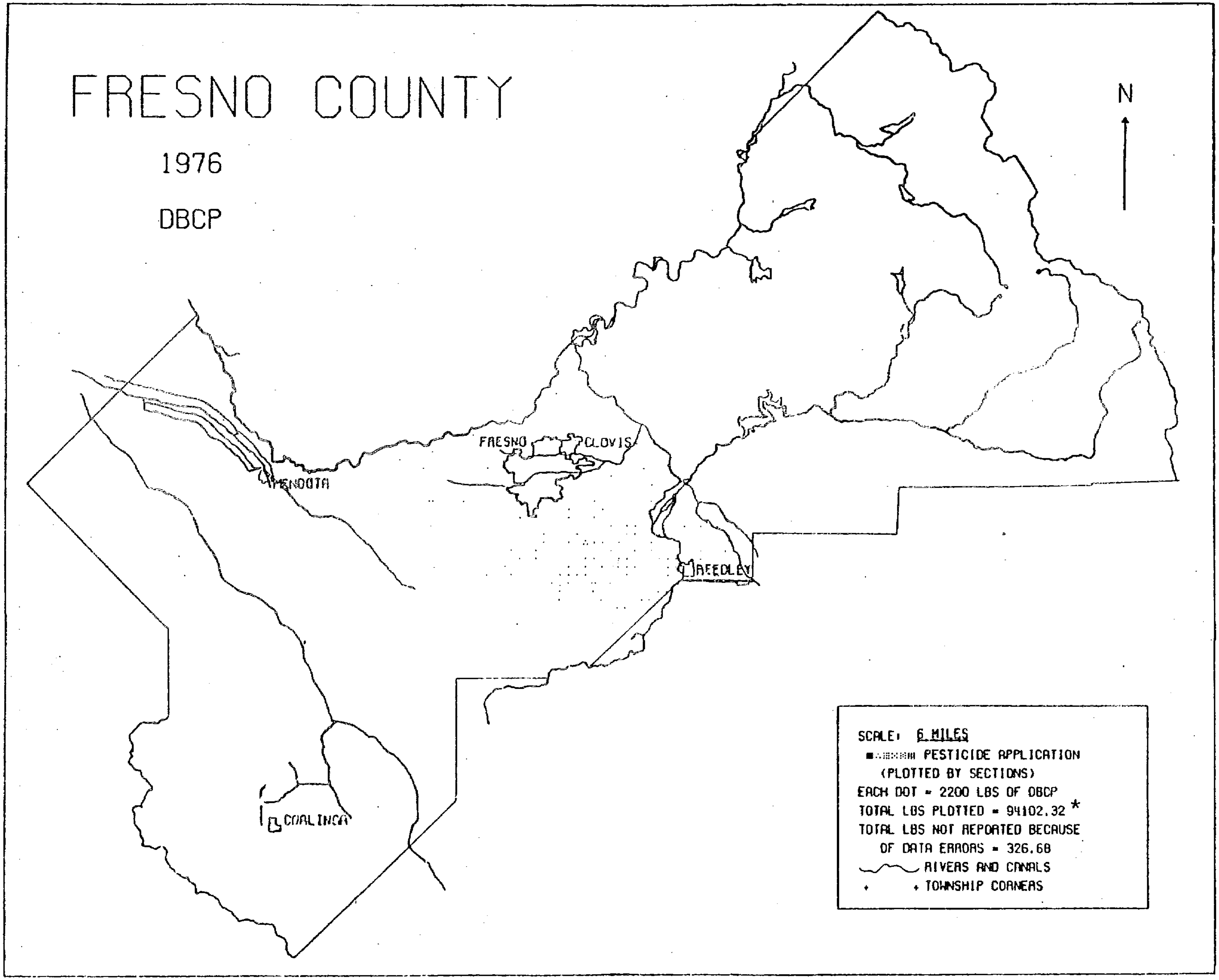

FRESNO COUNTY
1976
METHYL BROMIDE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 4500 LBS OF METHYL BROMIDE
TOTAL LBS PLOTTED - 158545.04*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 1650.16
RIVERS AND CANALS
+ TOWNSHIP CORNERS

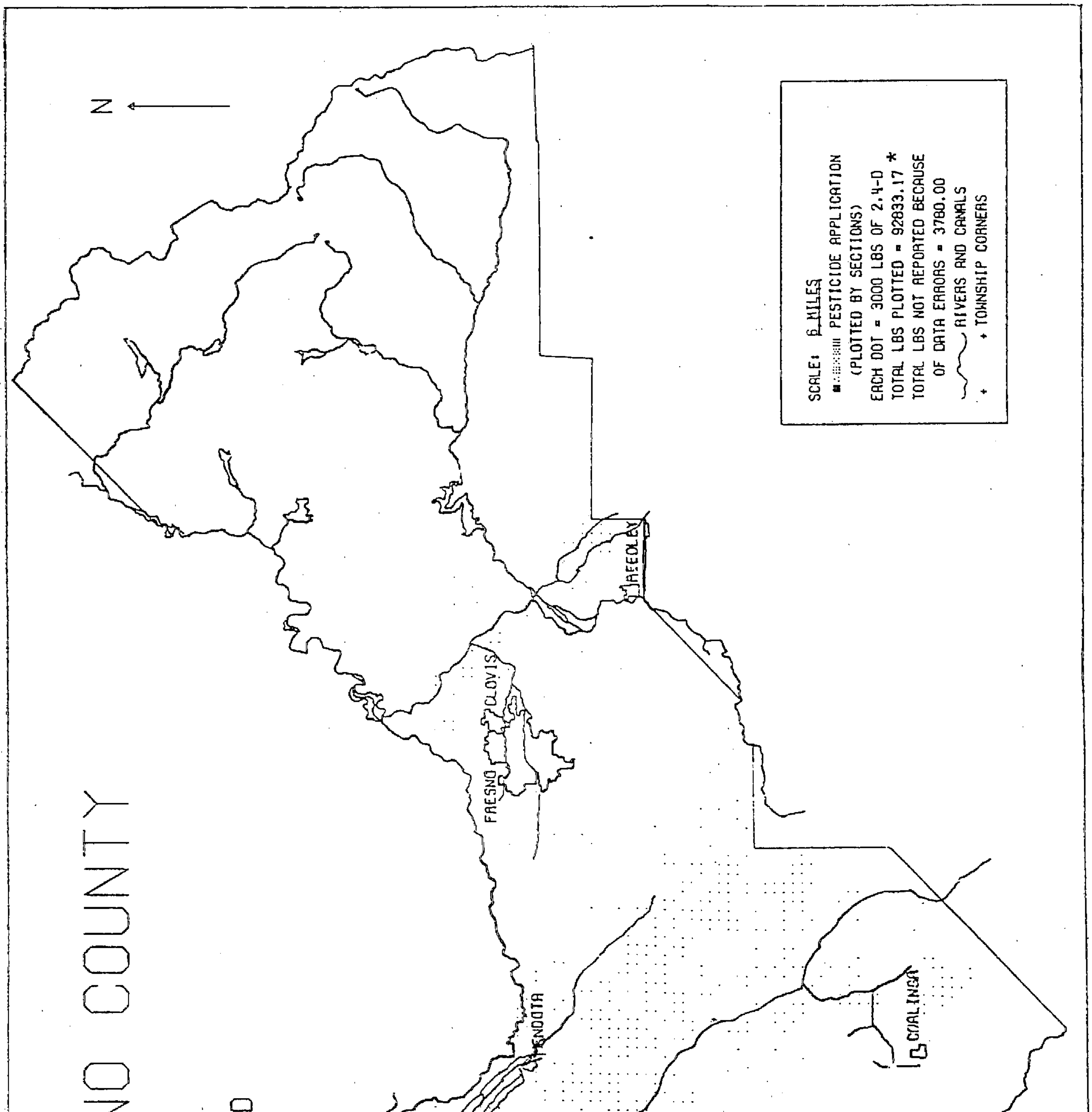

FRESNO COUNTY
1976
CACODYLATES
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 600 LBS OF CACODYLATES
TOTAL LBS PLOTTED = 123203.43 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 426.23
RIVERS AND CANALS
+ TOWNSHIP CORNERS

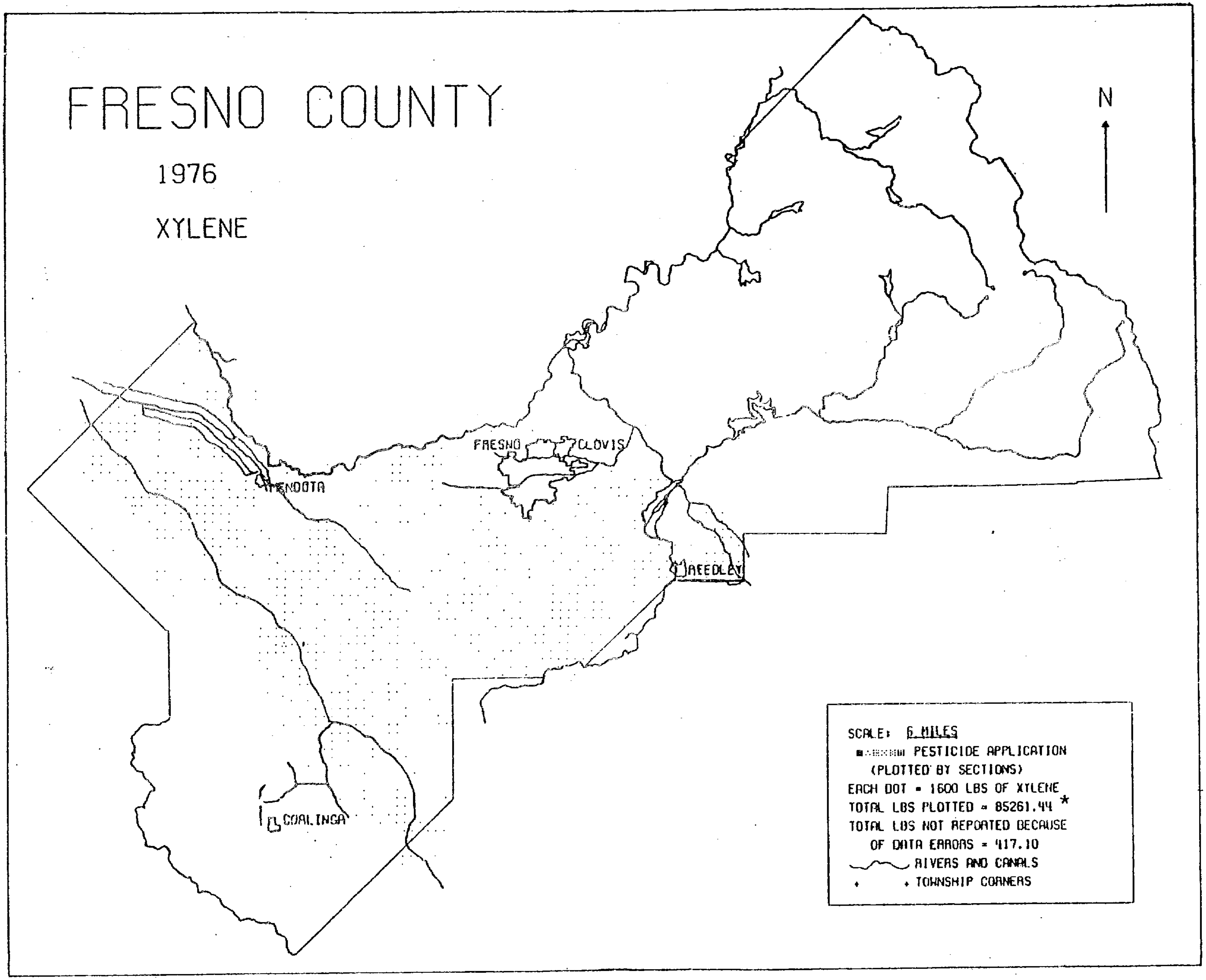

FRESNO COUNTY
1976
FOLEX
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 120 LBS OF FOLEX
TOTAL LBS PLOTTED = 122385.39 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 1432.54
RIVERS AND CANALS
+ TOWNSHIP CORNERS


FRESNO COUNTY
1976
DIMETHOATE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 260 LBS OF DIMETHOATE
TOTAL LBS PLOTTED = 105731.59*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 1877.12
RIVERS AND CANALS
+ TOWNSHIP CORNERS

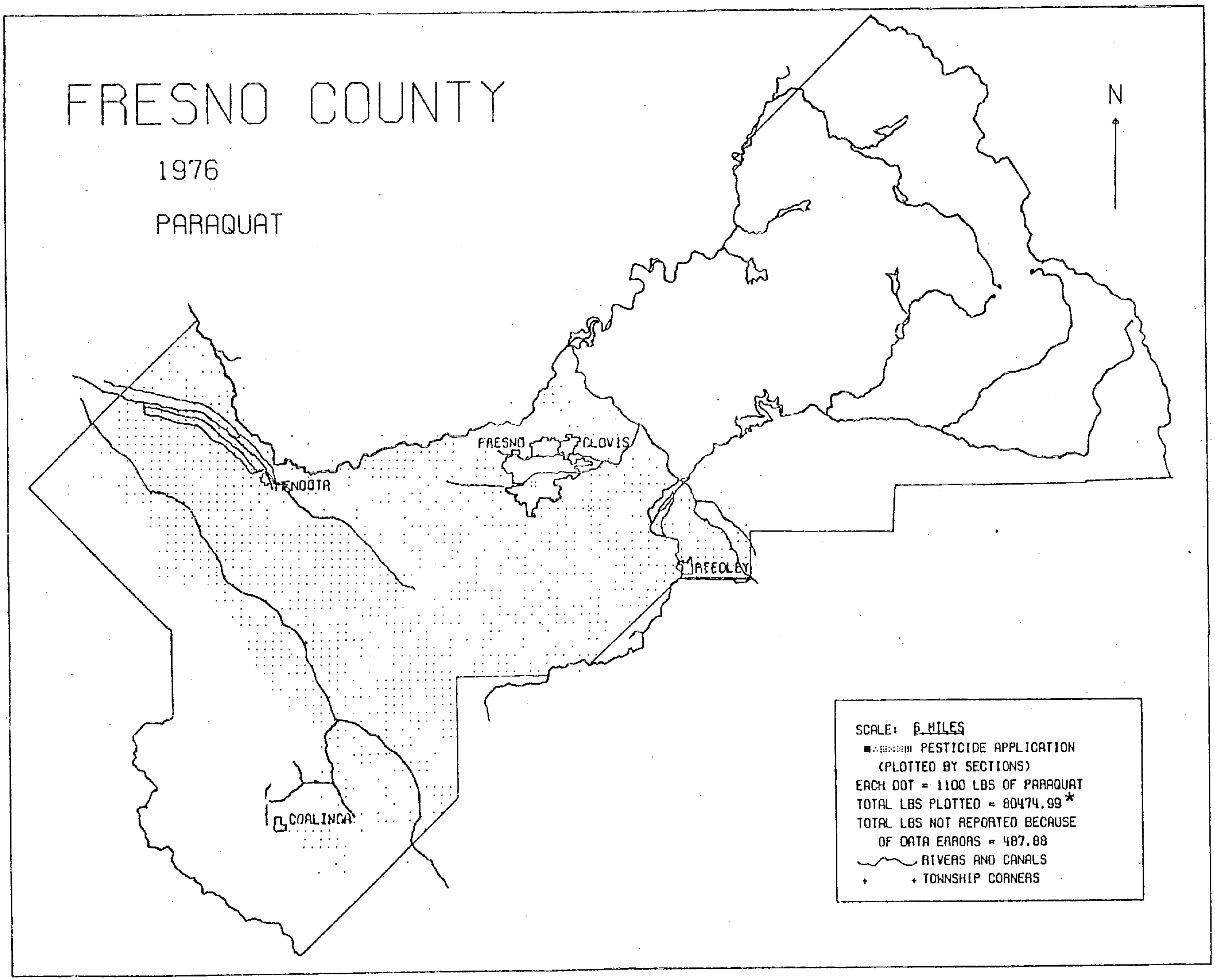

FRESNO COUNTY
1976
DNBP
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 2400 LBS OF DNBP
TOTAL LBS PLOTTED = 95872.81*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 1286.49
RIVERS AND CANALS
+ TOWNSHIP CORNERS

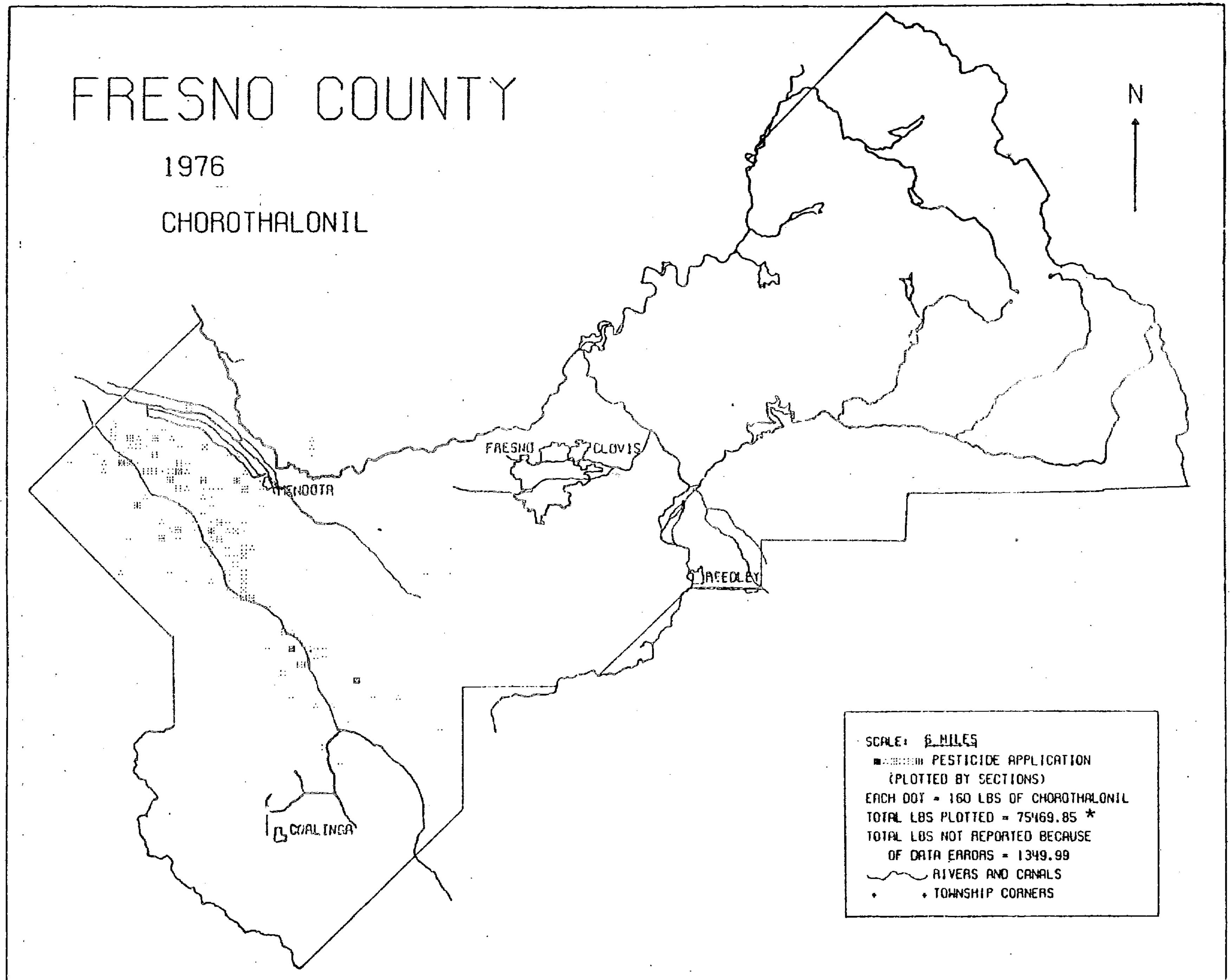

FRESNO COUNTY
1976
DBCP
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 2200 LBS OF DBCP
TOTAL LBS PLOTTED = 94102.32 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 326.68
RIVERS AND CANALS
TOWNSHIP CORNERS

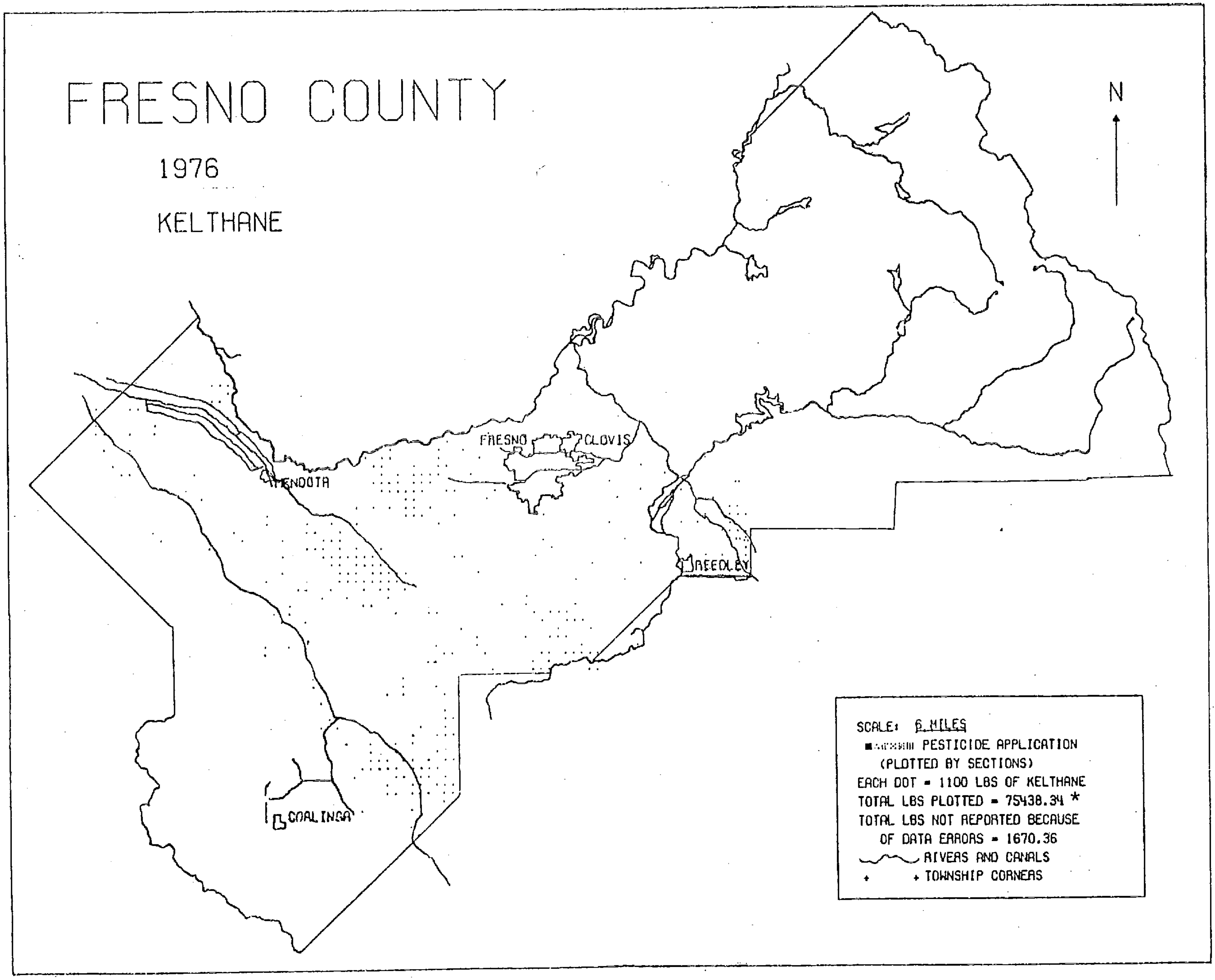

FRESNO COUNTY
1976
2,4-D
N
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 3000 LBS OF 2,4-D
TOTAL LBS PLOTTED = 92833.17 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 3780.00
RIVERS AND CANALS
+ TOWNSHIP CORNERS
REEDLEY
CLOVIS
FRESNO
MENDOTA
COALINGA

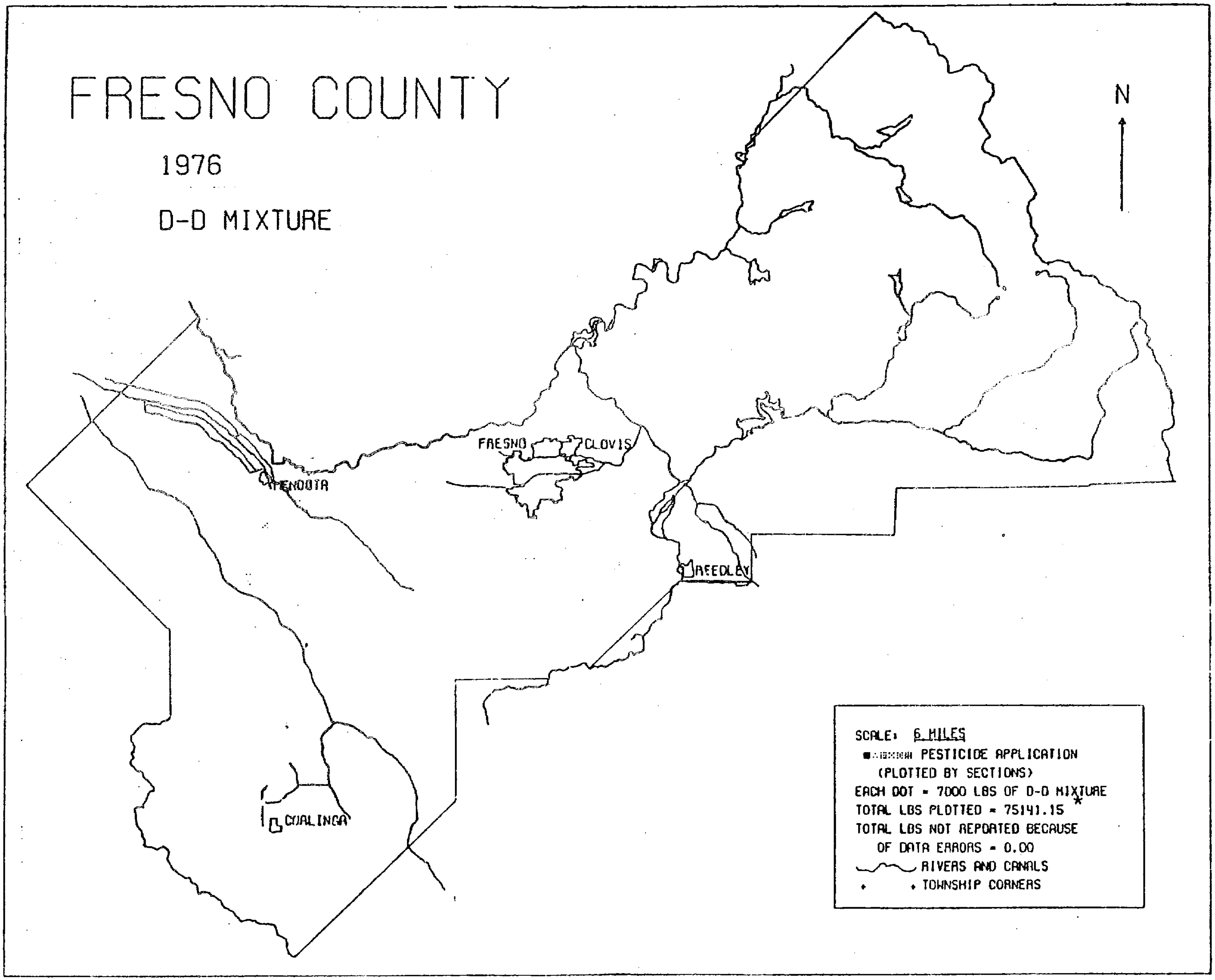


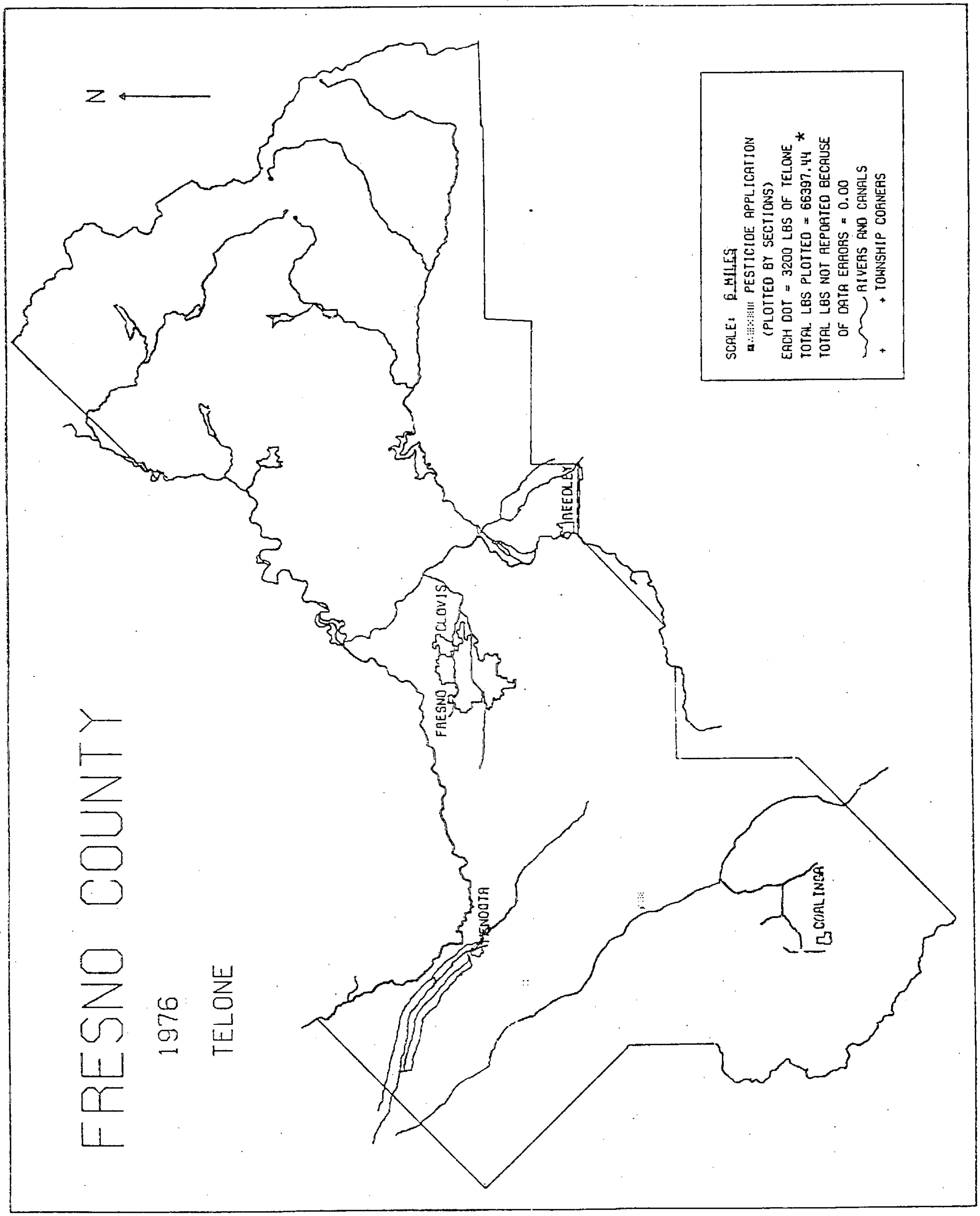
FRESNO COUNTY
1976
XYLENE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 1600 LBS OF XYLENE
TOTAL LBS PLOTTED = 85261.44 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 417.10
RIVERS AND CANALS
+ TOWNSHIP CORNERS

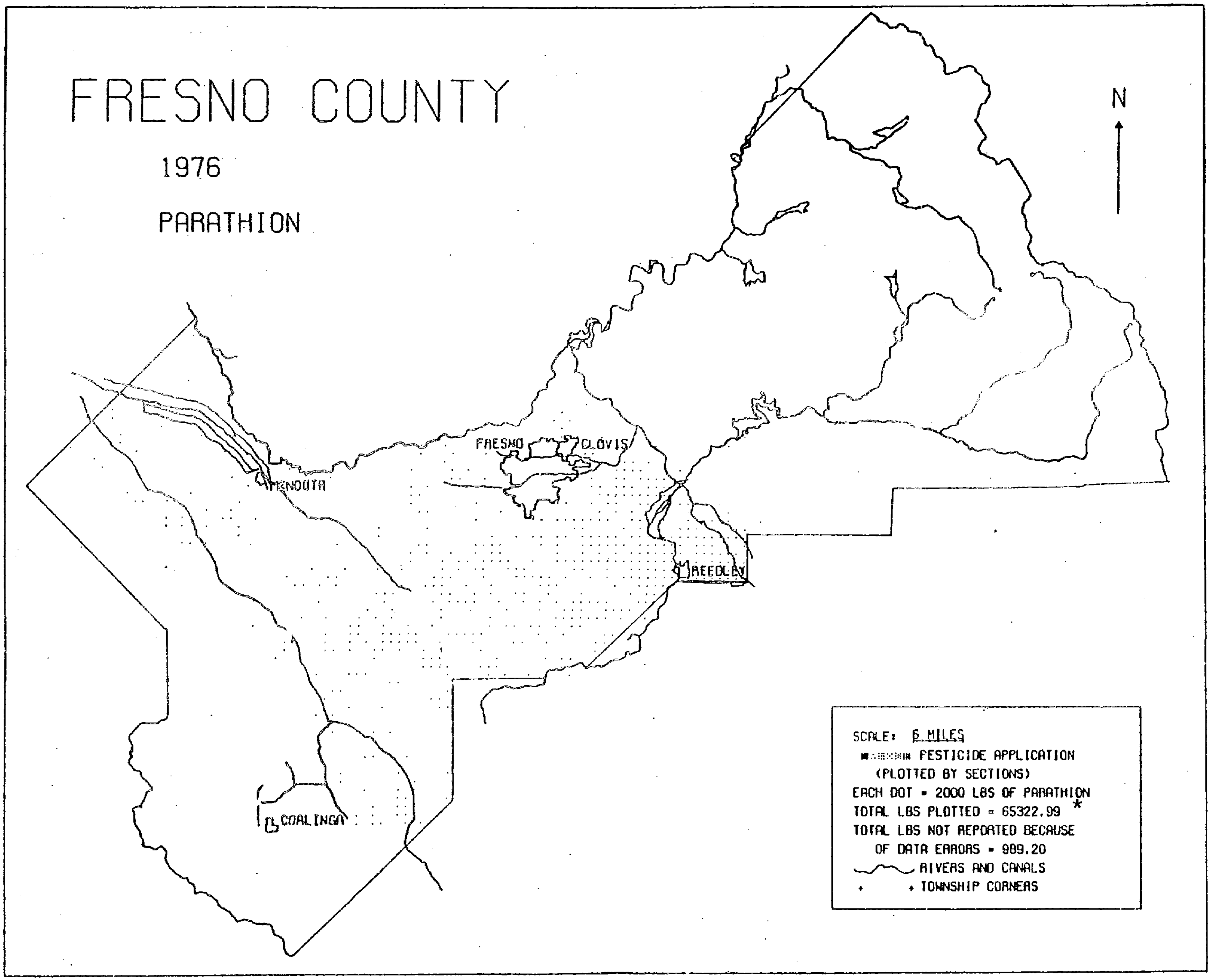

FRESNO COUNTY
1976
PARAQUAT
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 1100 LBS OF PARAQUAT
TOTAL LBS PLOTTED = 80474.99 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 487.88
RIVERS AND CANALS
+ TOWNSHIP CORNERS

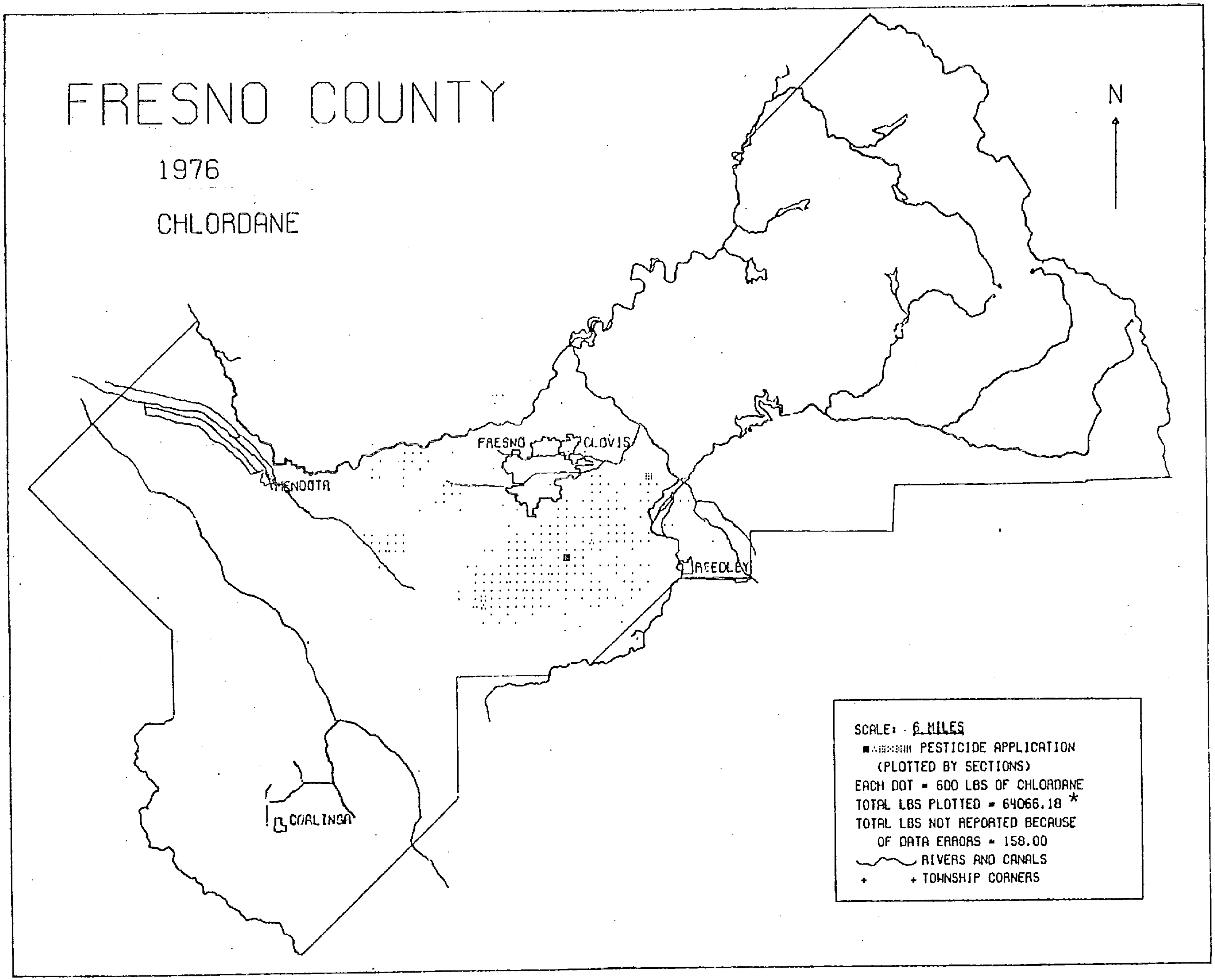

FRESNO COUNTY
1976
CHOROTHALONIL
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 160 LBS OF CHOROTHALONIL
TOTAL LBS PLOTTED = 75469.85 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 1349.99
RIVERS AND CANALS
TOWNSHIP CORNERS

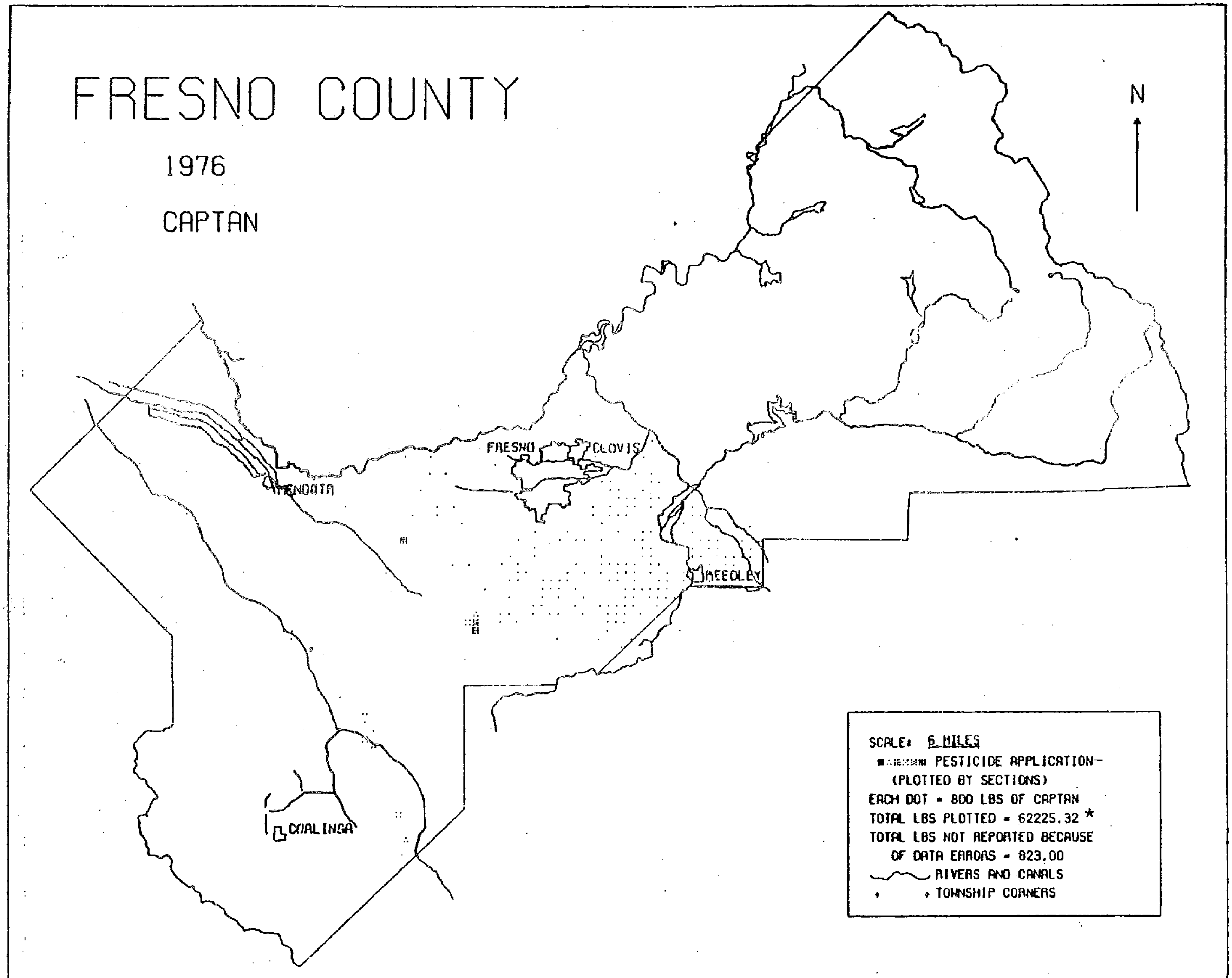

FRESNO COUNTY
1976
KELTHANE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 1100 LBS OF KELTHANE
TOTAL LBS PLOTTED = 75438.34 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 1670.36
RIVERS AND CANALS
+ TOWNSHIP CORNERS

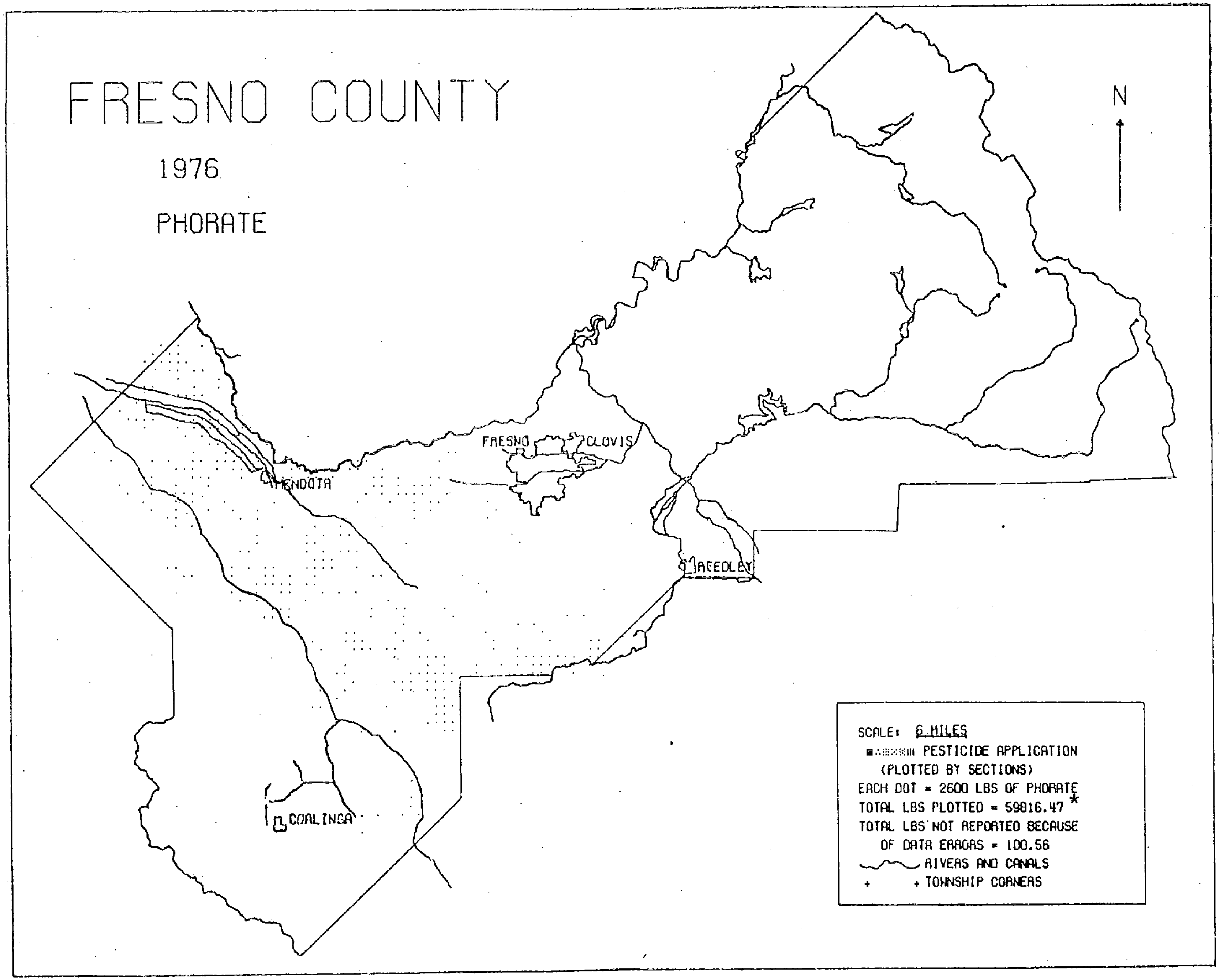

FRESNO COUNTY
1976
D-D MIXTURE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 7000 LBS OF D-D MIXTURE
TOTAL LBS PLOTTED = 75141.15
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 0.00
RIVERS AND CANALS
TOWNSHIP CORNERS

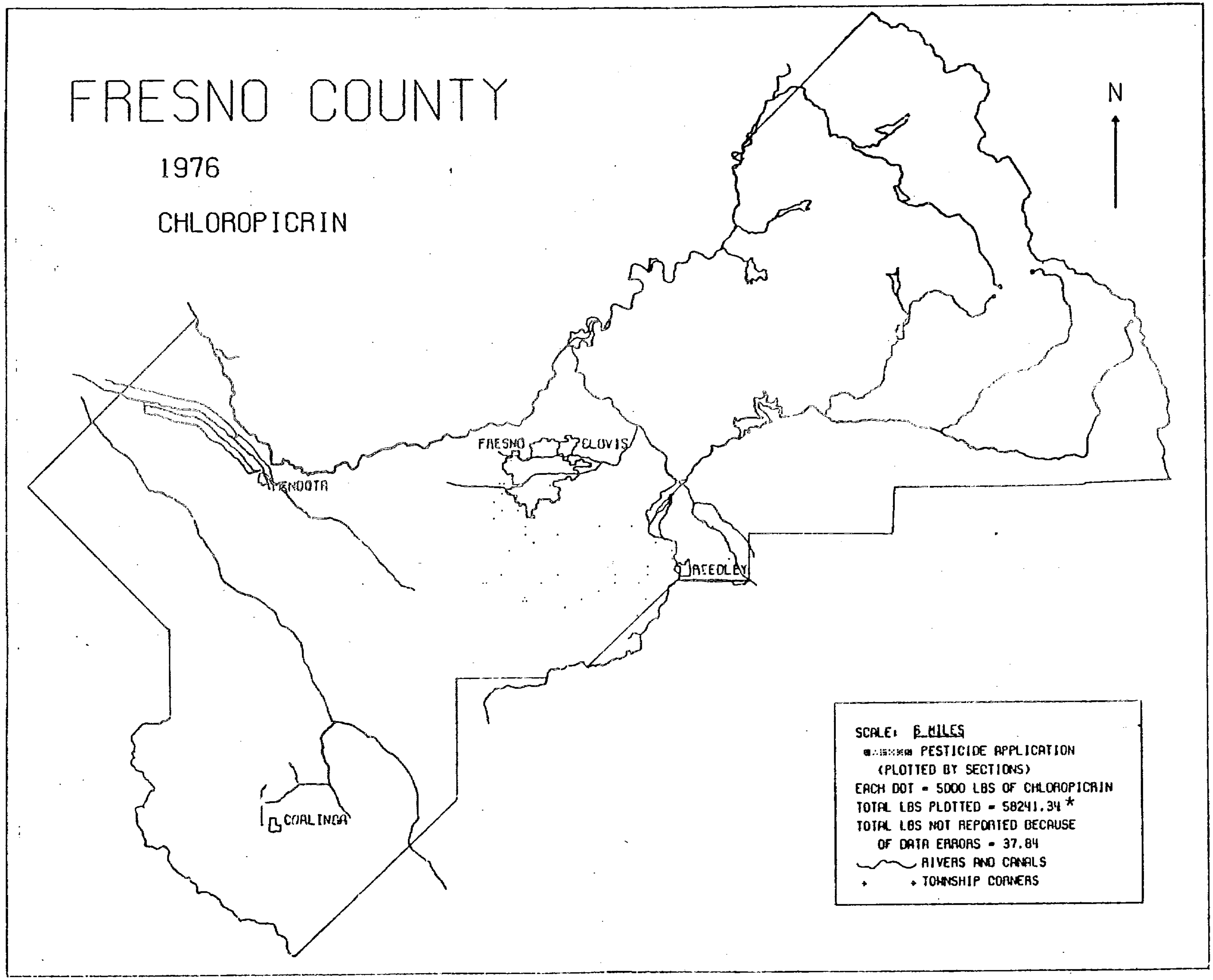

FRESNO COUNTY
1976
TELONE
N
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 3200 LBS OF TELONE
TOTAL LBS PLOTTED = 66397.44 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 0.00
RIVERS AND CANALS
+ TOWNSHIP CORNERS
REEDLEY
CLOVIS
FRESNO
MENDOTA
COALINGA

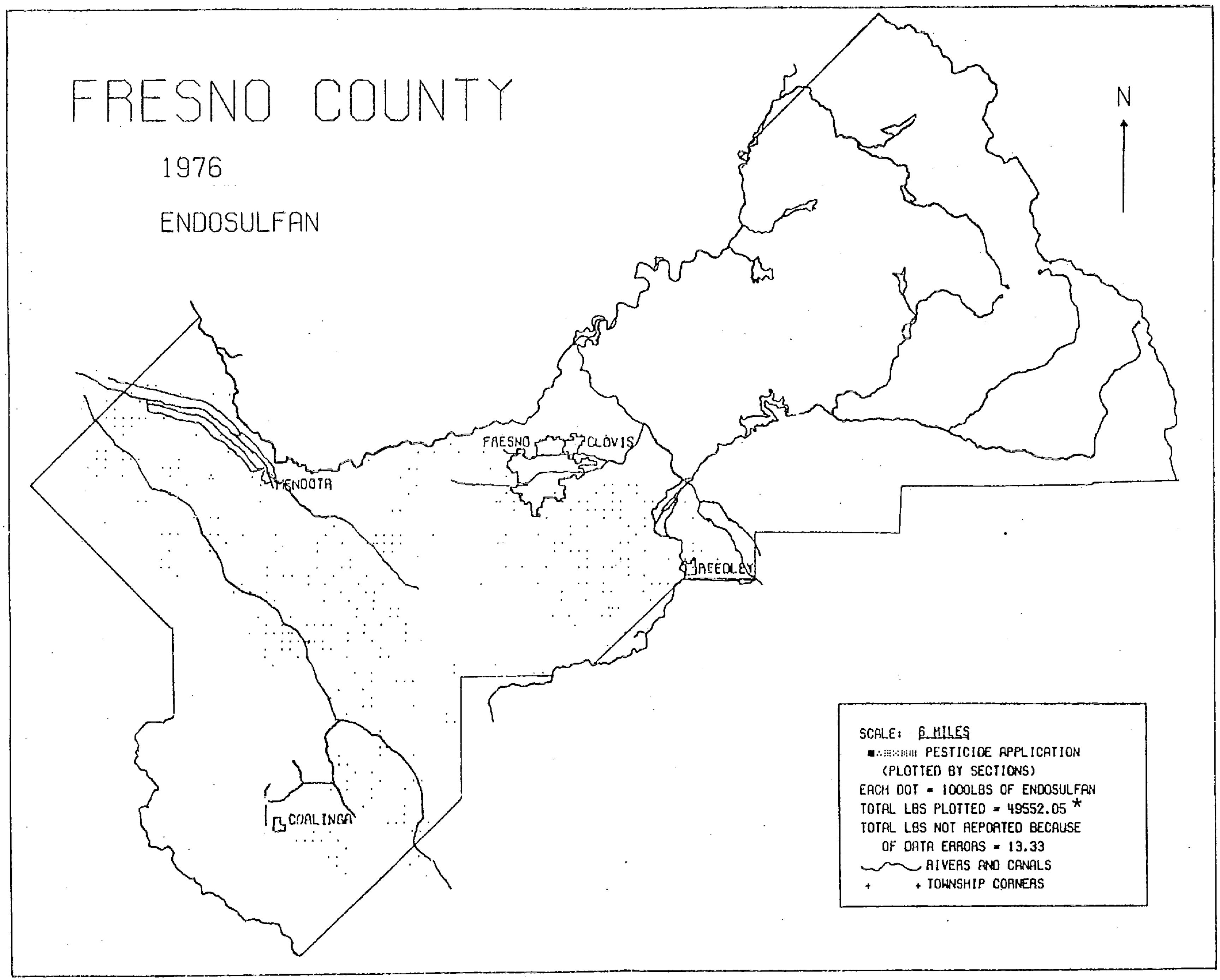

FRESNO COUNTY
1976
PARATHION
N
FRESNO
CLOVIS
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 2000 LBS OF PARATHION
TOTAL LBS PLOTTED = 65322.99 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 989.20
RIVERS AND CANALS
+ TOWNSHIP CORNERS

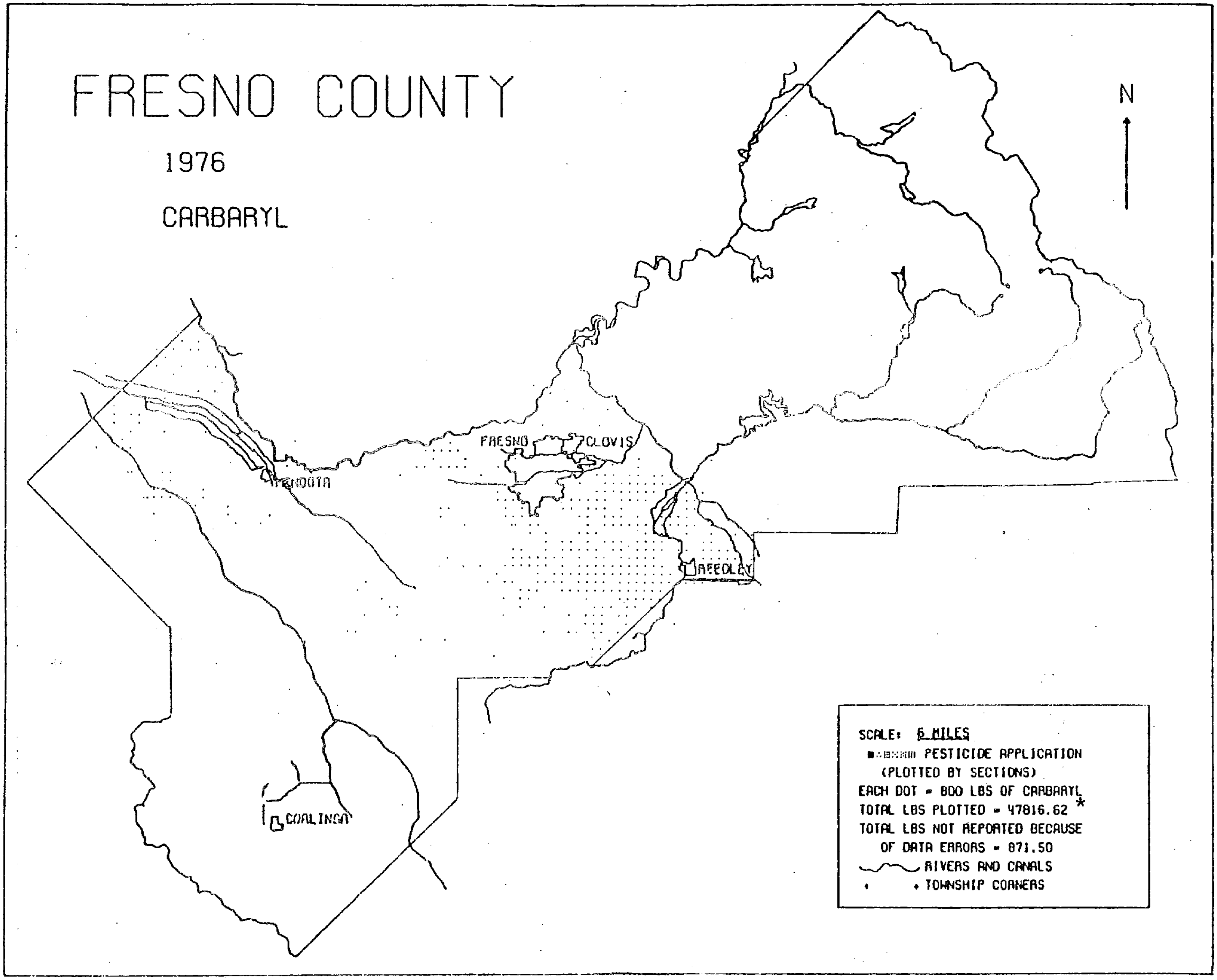

FRESNO COUNTY
1976
CHLORDANE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 600 LBS OF CHLORDANE
TOTAL LBS PLOTTED = 64066.18 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 158.00
RIVERS AND CANALS
+ TOWNSHIP CORNERS

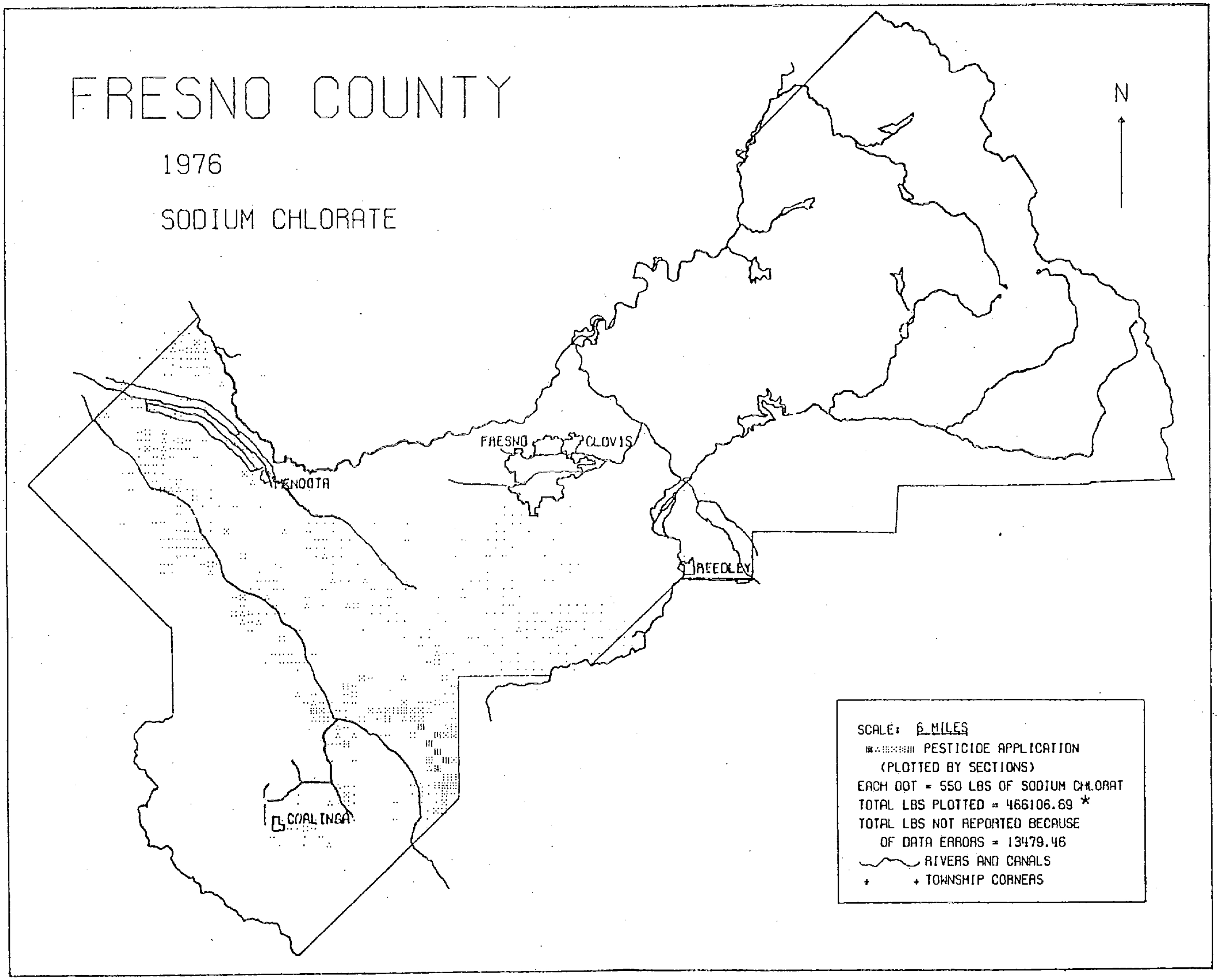

FRESNO COUNTY
1976
CAPTAN
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 800 LBS OF CAPTAN
TOTAL LBS PLOTTED = 62225.32 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 823.00
RIVERS AND CANALS
TOWNSHIP CORNERS

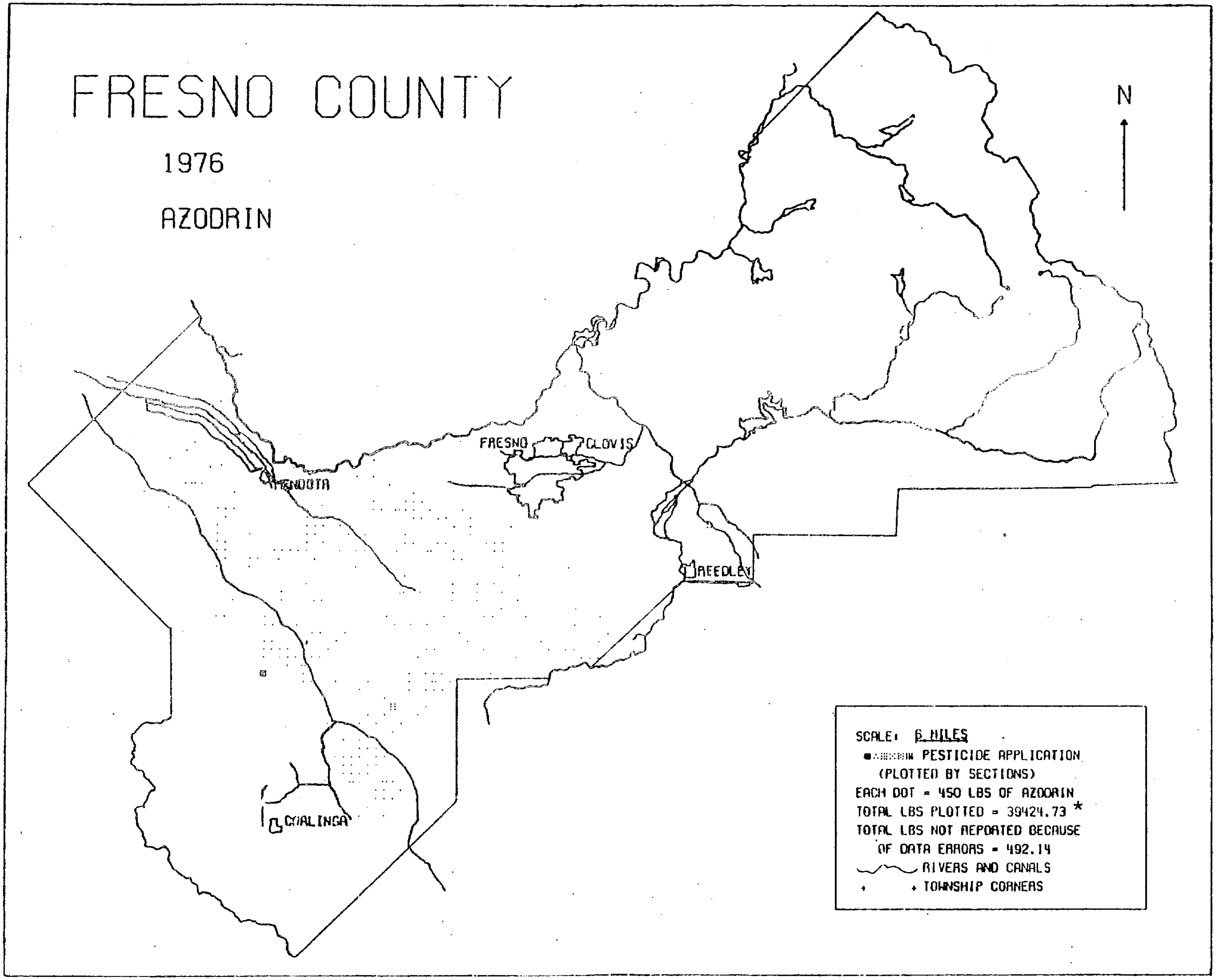

FRESNO COUNTY
1976
PHORATE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 2600 LBS OF PHORATE
TOTAL LBS PLOTTED = 59816.47 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 100.56
RIVERS AND CANALS
+ TOWNSHIP CORNERS

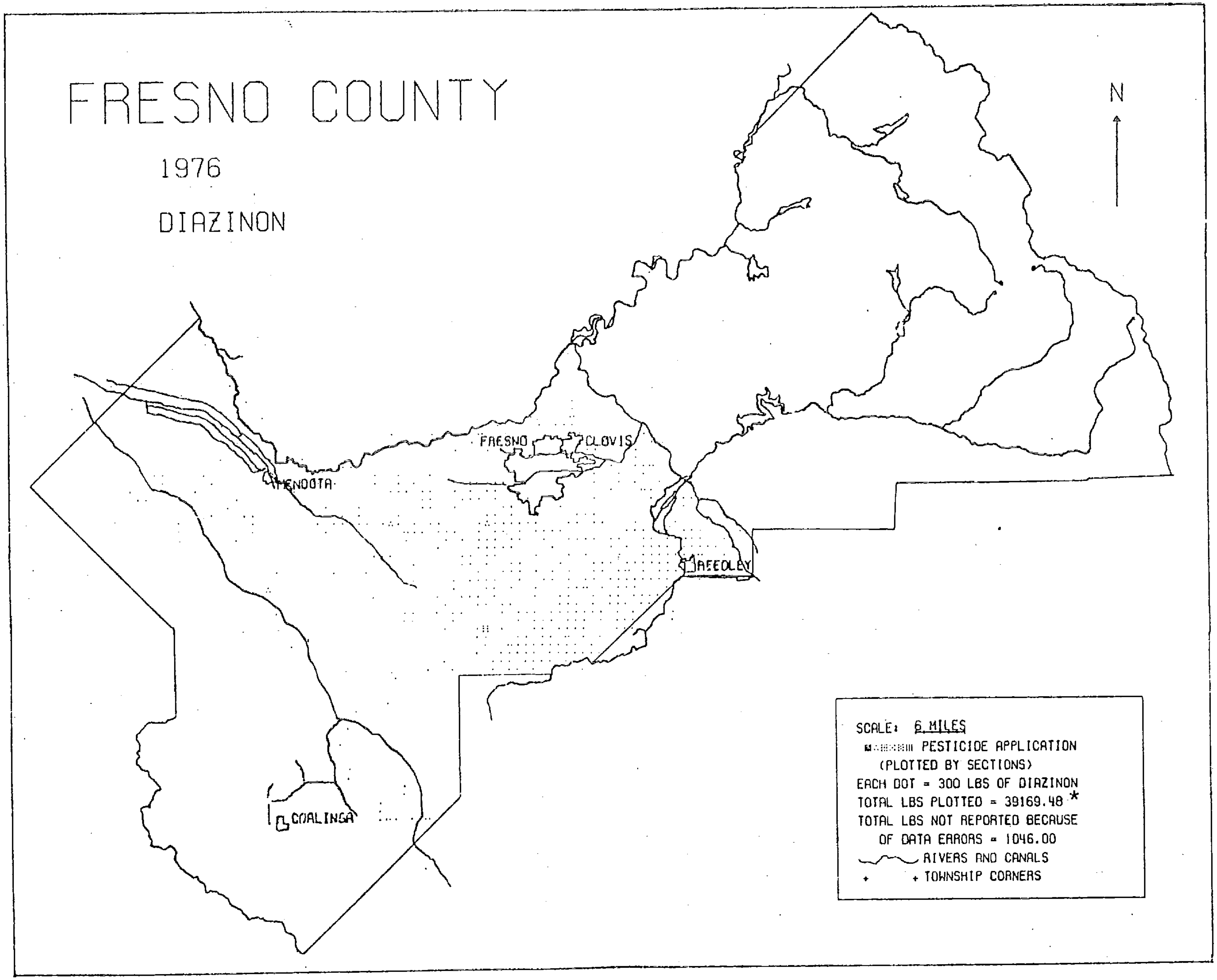

FRESNO COUNTY
1976
CHLOROPICRIN
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 5000 LBS OF CHLOROPICRIN
TOTAL LBS PLOTTED = 58241.34 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 37.84
RIVERS AND CANALS
+ TOWNSHIP CORNERS

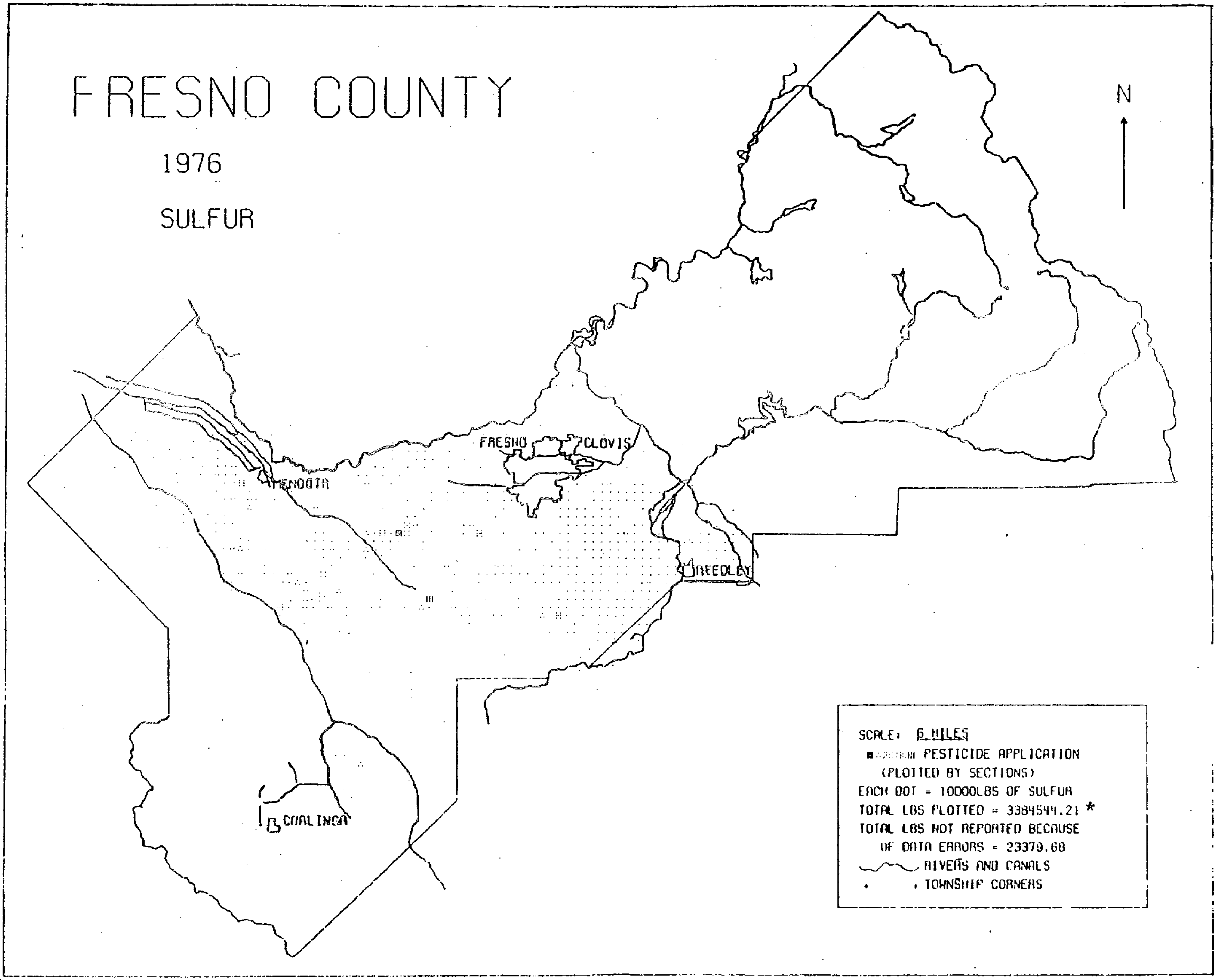

FRESNO COUNTY
1976
ENDOSULFAN
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 1000LBS OF ENDOSULFAN
TOTAL LBS PLOTTED = 49552.05 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 13.33
RIVERS AND CANALS
+ TOWNSHIP CORNERS

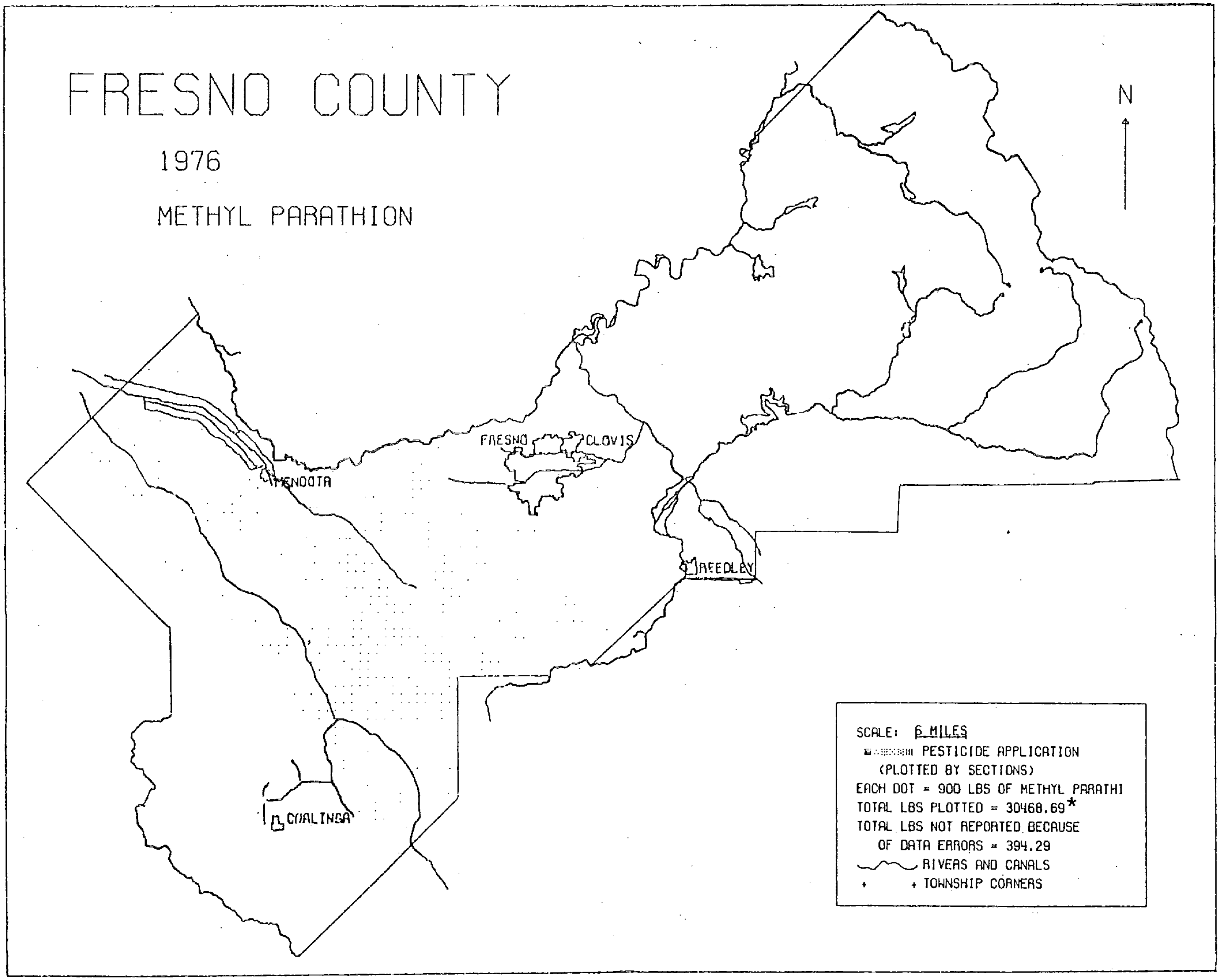

FRESNO COUNTY
1976
CARBARYL
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 800 LBS OF CARBARYL
TOTAL LBS PLOTTED = 47816.62 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 871.50
RIVERS AND CANALS
TOWNSHIP CORNERS

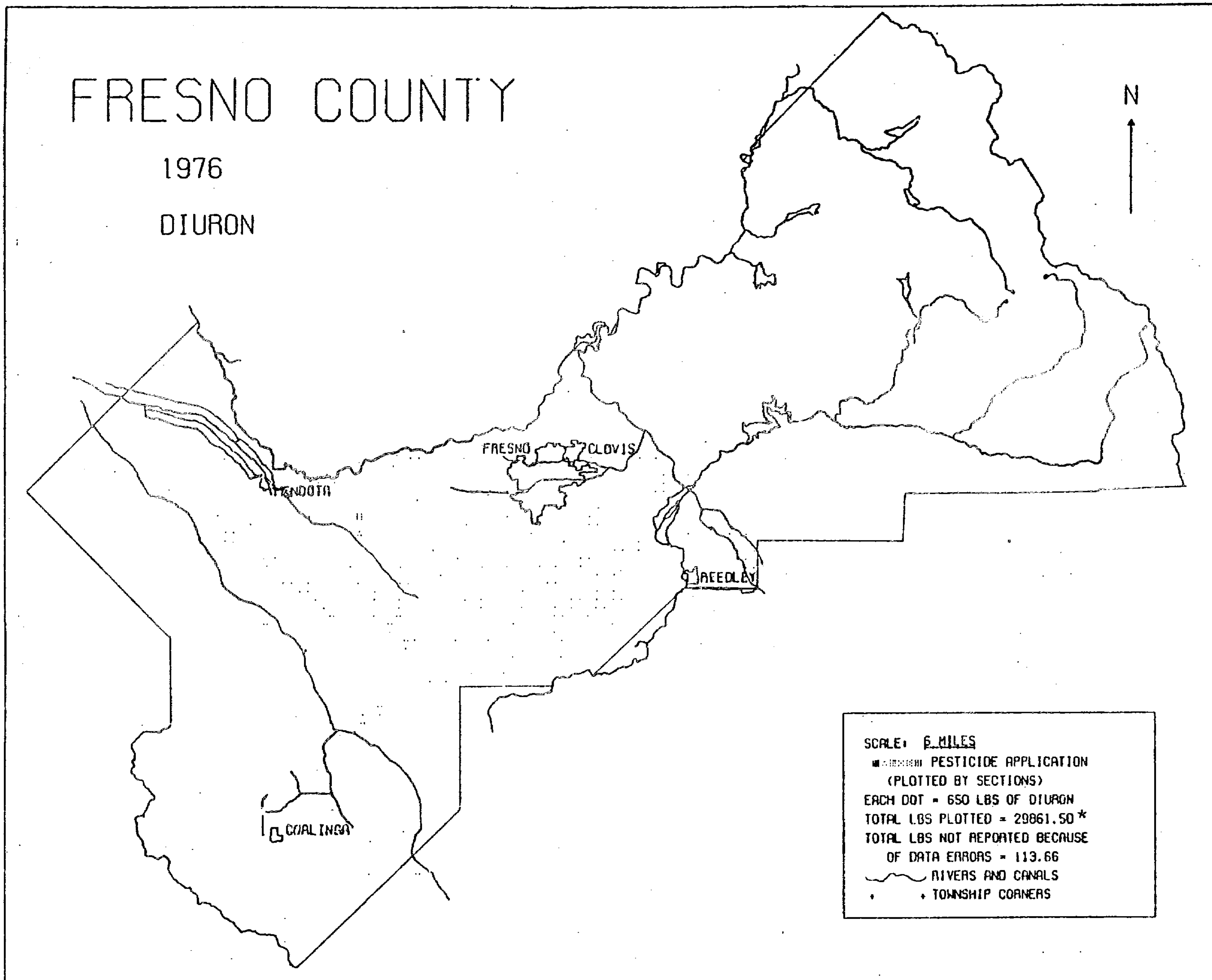

FRESNO COUNTY
1976
SODIUM CHLORATE
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 550 LBS OF SODIUM CHLORAT
TOTAL LBS PLOTTED = 466106.69 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 13479.46
RIVERS AND CANALS
+ TOWNSHIP CORNERS

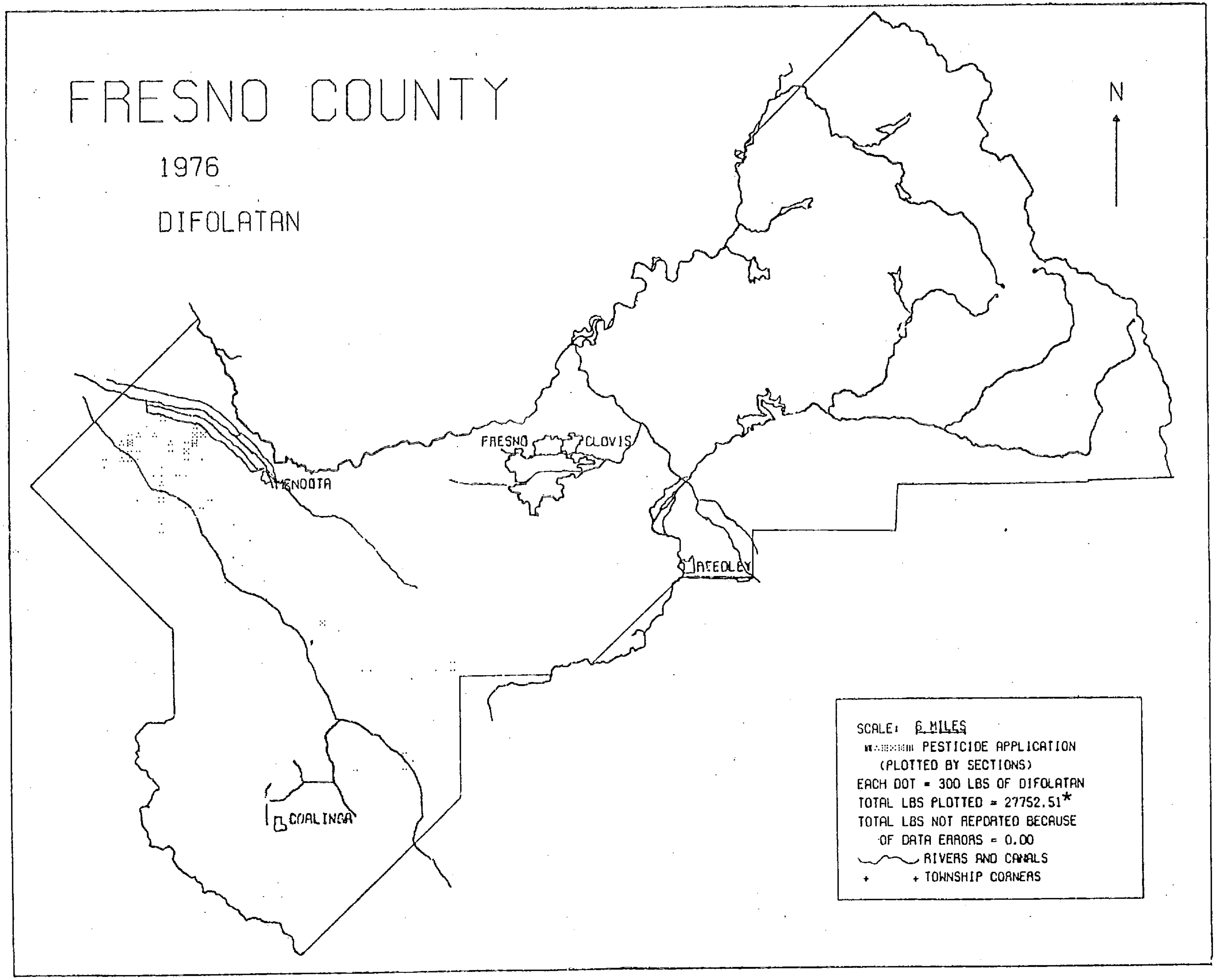

FRESNO COUNTY
1976
AZODRIN
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION (PLOTTED BY SECTIONS)
EACH DOT = 450 LBS OF AZODRIN
TOTAL LBS PLOTTED = 39424.73 *
TOTAL LBS NOT REPORTED BECAUSE OF DATA ERRORS = 492.14
RIVERS AND CANALS
+ TOWNSHIP CORNERS

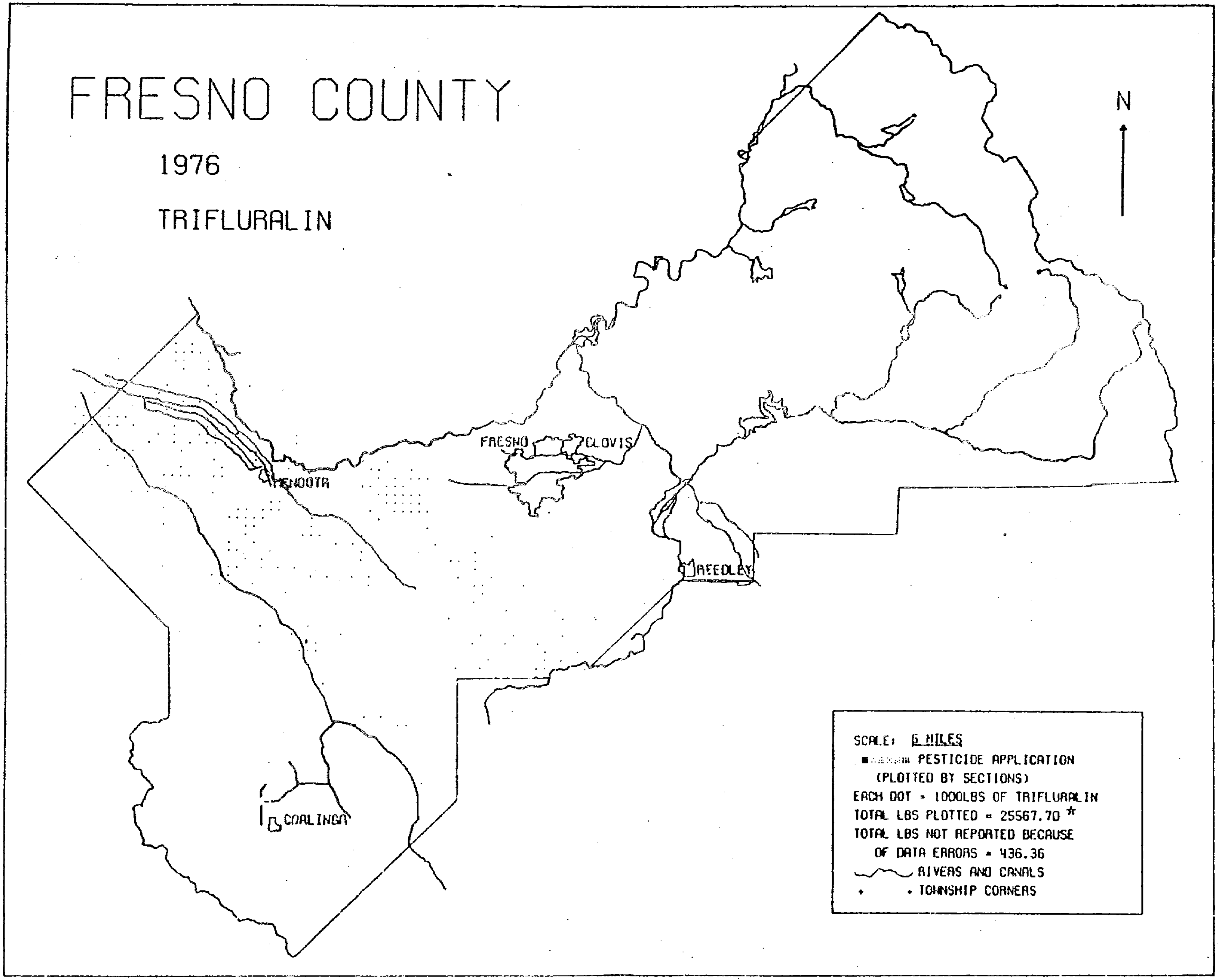

FRESNO COUNTY
1976
DIAZINON
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 300 LBS OF DIAZINON
TOTAL LBS PLOTTED = 39169.48 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 1046.00
RIVERS AND CANALS
+ TOWNSHIP CORNERS

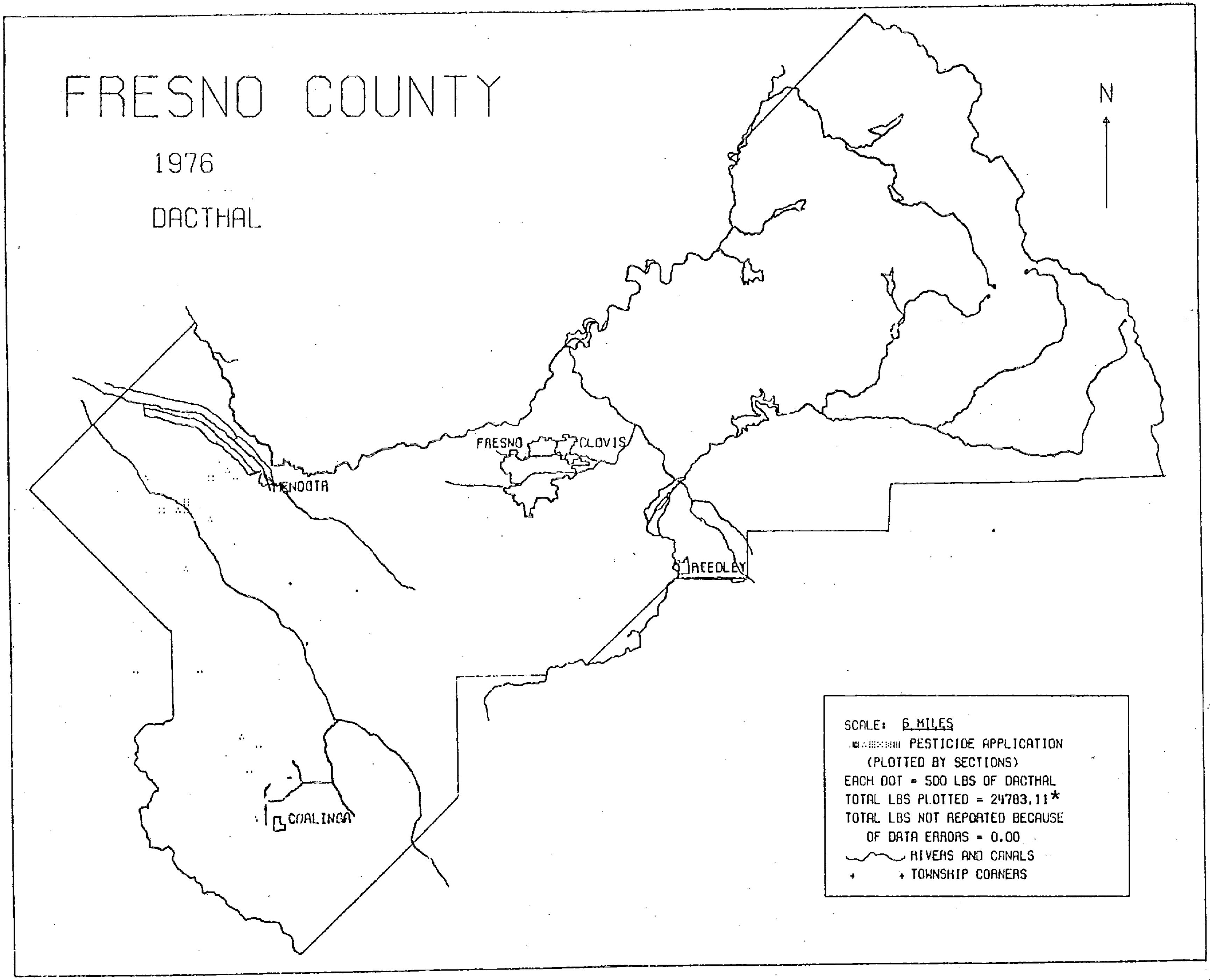

FRESNO COUNTY
1976
SULFUR
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 10000LBS OF SULFUR
TOTAL LBS PLOTTED = 3384544.21 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 23370.60
RIVERS AND CANALS
TOWNSHIP CORNERS

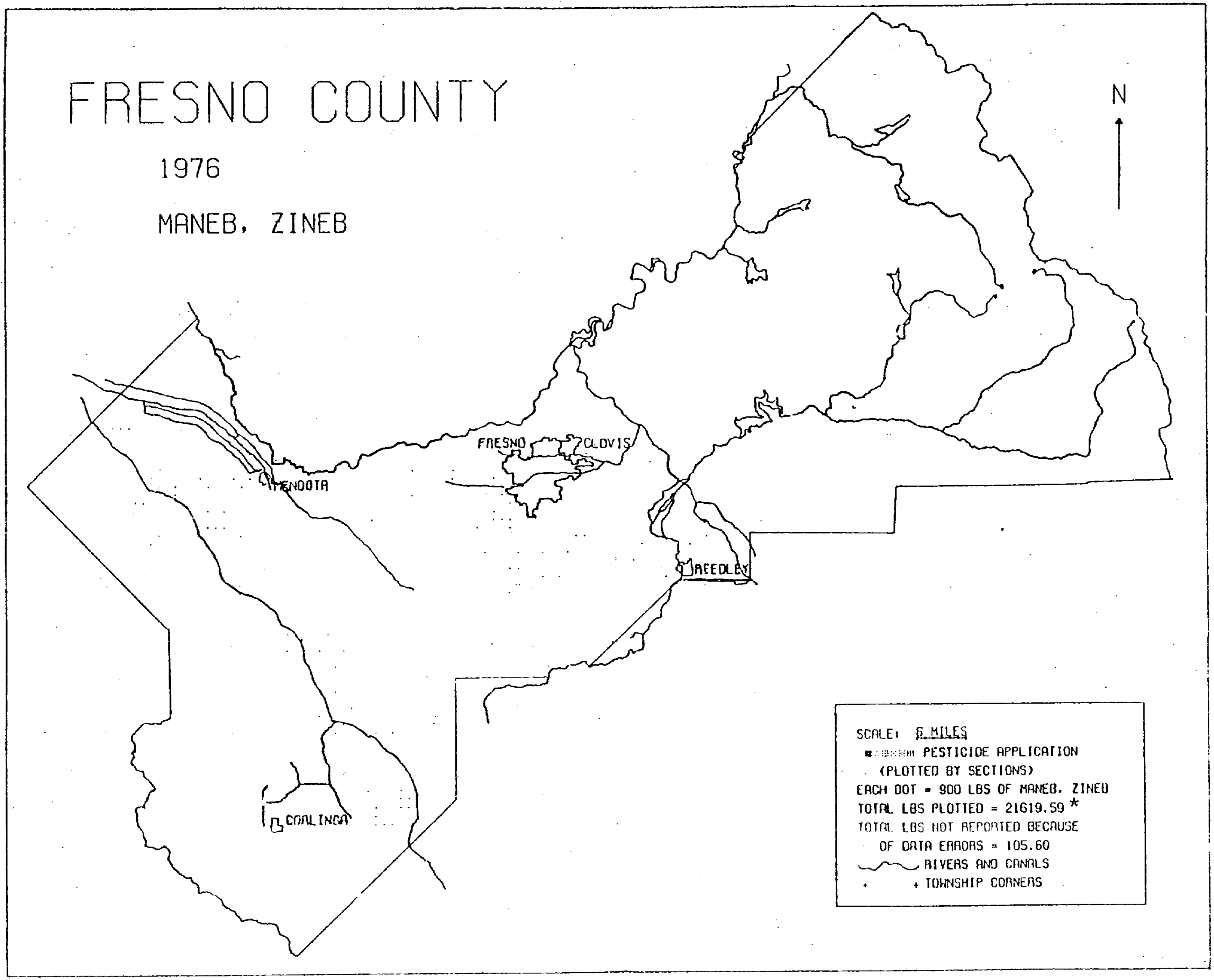

FRESNO COUNTY
1976
METHYL PARATHION
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 900 LBS OF METHYL PARATHI
TOTAL LBS PLOTTED = 30468.69*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 394.29
RIVERS AND CANALS
+ TOWNSHIP CORNERS

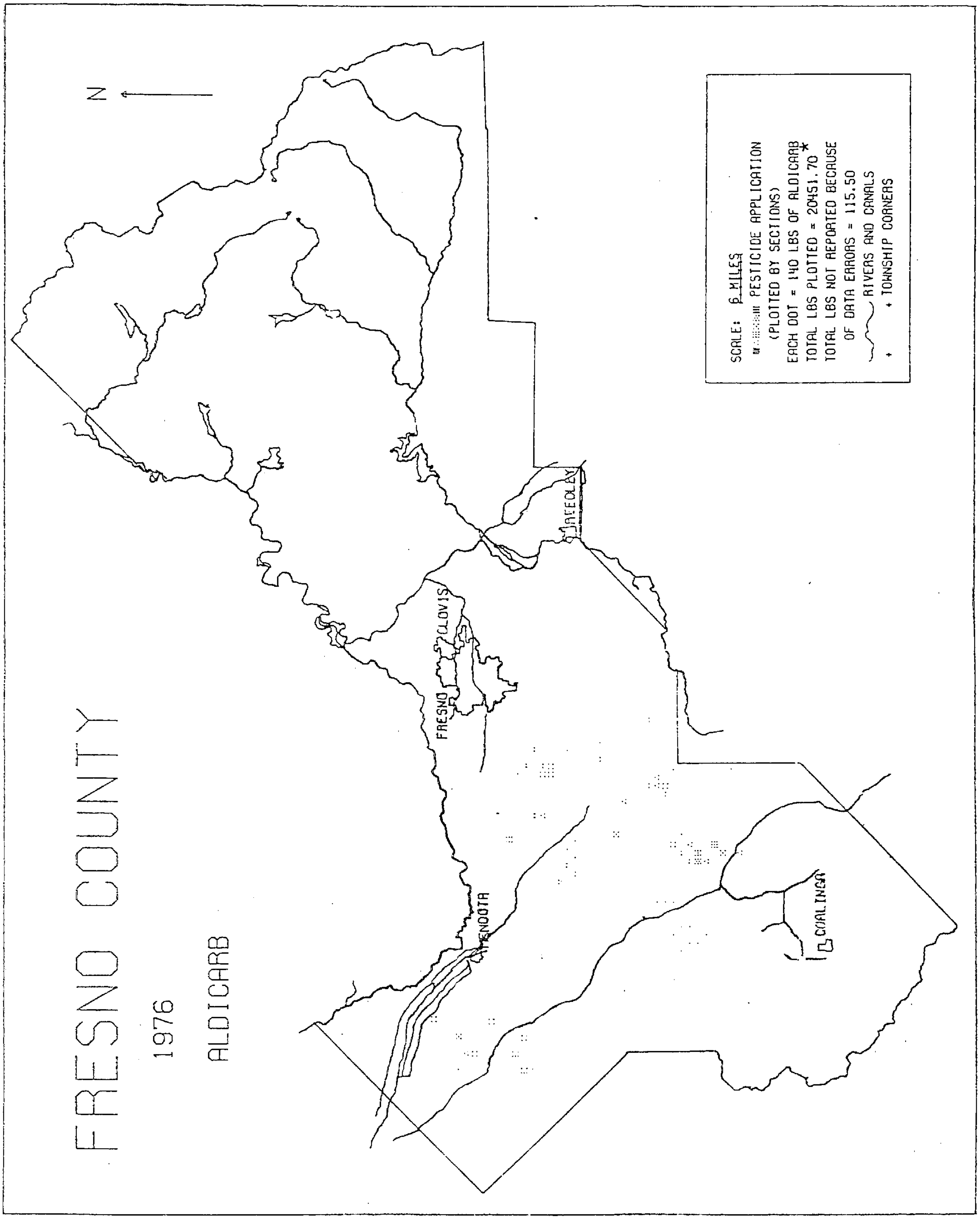

FRESNO COUNTY
1976
DIURON
N
FRESNO
CLOVIS
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 650 LBS OF DIURON
TOTAL LBS PLOTTED = 29861.50 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 113.66
RIVERS AND CANALS
+ TOWNSHIP CORNERS


FRESNO COUNTY
1976
DIFOLATAN
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 300 LBS OF DIFOLATAN
TOTAL LBS PLOTTED = 27752.51*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 0.00
RIVERS AND CANALS
+ TOWNSHIP CORNERS


FRESNO COUNTY
1976
TRIFLURALIN
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 1000LBS OF TRIFLURALIN
TOTAL LBS PLOTTED = 25567.70 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 436.36
RIVERS AND CANALS
TOWNSHIP CORNERS


FRESNO COUNTY
1976
DACTHAL
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 500 LBS OF DACTHAL
TOTAL LBS PLOTTED = 24783.11*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 0.00
RIVERS AND CANALS
+ TOWNSHIP CORNERS


FRESNO COUNTY
1976
MANEB, ZINEB
N
FRESNO
CLOVIS
MENDOTA
REEDLEY
COALINGA
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 900 LBS OF MANEB, ZINEB
TOTAL LBS PLOTTED = 21619.59 *
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 105.60
RIVERS AND CANALS
+ TOWNSHIP CORNERS


FRESNO COUNTY
1976
ALDICARB
N
SCALE: 6 MILES
PESTICIDE APPLICATION
(PLOTTED BY SECTIONS)
EACH DOT = 140 LBS OF ALDICARB
TOTAL LBS PLOTTED = 20451.70*
TOTAL LBS NOT REPORTED BECAUSE
OF DATA ERRORS = 115.50
RIVERS AND CANALS
TOWNSHIP CORNERS
REEDLEY
CLOVIS
FRESNO
MENDOTA
COALINGA

APPENDIX F

SELECTED PESTICIDES* USED FOR

CROPS IN FRESNO COUNTY

(PUR REPORTED VALUES)

*Pounds of restricted and nonrestricted pesticides applied should be multiplied by a factor of 1.13 or 1.47, respectively.

USE OF SELECTED PESTICIDES IN 1976 IN FRESNO COUNTY

	CODES	AIR LBS	AIR ACRES	GROUND LBS	GROUND ACRES	OTHER LBS	OTHER ACRES	TOTAL LBS	TOTAL ACRES
AGENCIES, OTHER	(000200)								
- - METHYL BROMIDE	00385	0	0	0	0	0	0	60,149	0
- - PHORATE	00478	0	0	0	0	0	0	2,176	0
- - PHOSTOXIN-R	00484	0	0	0	0	0	0	552	0
- - CARBARYL	00105	0	0	0	0	0	0	186	0
- - MCPA, ISOOCTYL ESTER	00787	0	0	0	0	0	0	119	0
- - 2,4-D, DIMETHYLAMINE SALT	00806	0	0	0	0	0	0	118	0
- - CHLORDANE	00130	0	0	0	0	0	0	104	0
- - 2,4-D, ISOPROPYL ESTER	00810	0	0	0	0	0	0	90	0
- - PARAQUAT DICHLORIDE	01601	0	0	0	0	0	0	56	0
- - ZINC PHOSPHIDE	00626	0	0	0	0	0	0	16	0
- - LEAD ARSENATE (BASIC)	00354	0	0	0	0	0	0	8	0
- - CHLOROPICRIN	00136	0	0	0	0	0	0	3	0
- - CARBOPHENTHION	00110	0	0	0	0	0	0	0	0
- - AVITROL 200-R	00050	0	0	0	0	0	0	0	0
ALFALFA	(000300)								
TOXAPHENE	00594	16,133	5,480	0	0	0	0	16,133	5,480
TEPP, OTHER RELATED	90577	15,580	15,480	0	0	0	0	15,580	15,480
METHOMYL	00383	13,178	26,955	19	30	17	37	13,214	27,022
METHYL PARATHION	00394	11,449	19,730	56	291	7	24	11,512	20,053
ENDOSULFAN	00259	10,928	14,884	0	0	120	210	11,048	15,094
-U- ENDOSULFAN	00259	0	150	0	0	0	0	0	150
TEPP	00577	10,387	15,480	0	0	0	0	10,387	15,480
PARATHION	00459	8,423	17,600	112	291	0	0	8,535	17,891
CARBOFURAN	00106	7,002	17,189	30	120	0	0	7,032	17,309
SUPRACIDE-R	01689	5,365	8,914	101	220	64	85	5,530	9,219
PHOSDRIN-R	00480	4,542	20,495	20	135	23	75	4,585	20,705
BIDRIN-R	00072	3,716	5,669	163	311	0	0	3,879	5,980
PHOSDRIN-R, OTHER RELATED	90480	3,021	20,495	13	135	15	75	3,050	20,705
4(2,4-DB), ISOOCTYL ESTER	01385	2,093	1,616	218	300	0	0	2,311	1,916
CARBARYL	00105	1,527	953	0	0	0	0	1,527	953
2,4-D	00636	987	410	0	0	0	0	987	410
PARAQUAT DICHLORIDE	01601	304	1,191	0	0	0	0	304	1,191
4(2,4-DB), DIMETHYLAMINE SALT	00838	211	230	0	0	0	0	211	230
DEMETON	00566	182	1,092	0	0	0	0	182	1,092
ALDICARB	00575	0	0	180	60	0	0	180	60
4(2,4-DB), BUTOXYETHANOL ESTER	00837	154	120	0	0	0	0	154	120
MCPA, DIMETHYLAMINE SALT	00786	74	50	0	0	0	0	74	50
DI-SYSTON-R	00230	52	70	0	0	0	0	52	70
GUTHION-R	00314	25	50	0	0	0	0	25	50
ZINC PHOSPHIDE	00626	0	0	2	274	0	0	2	274
ALMONDS	(000400)								
GUTHION-R	00314	6,090	4,202	567	399	0	0	6,657	4,601
PARATHION	00459	76	38	2,883	1,983	0	0	2,959	2,021
CARBARYL	00105	29	6	1,949	521	0	0	1,977	527
ENDOSULFAN	00259	1,398	1,762	0	0	60	80	1,458	1,842
PARAQUAT DICHLORIDE	01601	0	0	1,255	3,216	51	79	1,307	3,295
CARBOPHENTHION	00110	10	10	270	278	0	0	280	288
APRICOT	(000700)								
PARATHION	00459	0	0	52	27	0	0	52	27
PARAQUAT DICHLORIDE	01601	0	0	44	110	0	0	44	110
CARBARYL	00105	43	12	0	0	0	0	43	12

ARTICHOKE	(000800)								
ENDOSULFAN	00259	0	0	1	2	0	0	1	2
AVOCADO	(001000)								
PARATHION	00459	0	0	76	94	0	0	76	94
PARAQUAT DICHLORIDE	01601	0	0	10	40	0	0	10	40
BARLEY	(001100)								
2,4-D, DIMETHYLAMINE SALT	00806	36,966	47,130	0	0	23	26	36,989	47,156
2,4-D, ALKANOLAMINE SALTS (ETH	00801	26,879	26,606	0	0	0	0	26,879	26,606
PHORATE	00478	13,270	13,625	0	0	102	105	13,372	13,730
DI-SYSTON-R	00230	7,174	3,553	0	0	0	0	7,174	3,553
2,4-D	00636	6,824	7,473	0	0	0	0	6,824	7,473
METHYL PARATHION	00394	6,440	25,165	0	0	12	20	6,452	25,185
2,4-D, N-OLEYL-1,3-PROPYLENEDI	01096	6,306	9,359	0	0	0	0	6,306	9,359
PARATHION	00459	3,816	10,794	0	0	0	0	3,816	10,794
2,4-D, BUTYL ESTER	00804	2,522	1,795	0	0	0	0	2,522	1,795
PARAQUAT DICHLORIDE	01601	1,871	10,372	140	745	0	0	2,011	11,117
MCPA, DIMETHYLAMINE SALT	00786	1,999	3,673	0	0	0	0	1,999	3,673
CHLORDANE	00130	0	0	133	100	0	0	133	100
DEMETON	00566	6	24	0	0	0	0	6	24
-P- METHYL BROMIDE	00385	0	0	0	0	2	260,000	2	260,000
-P- CHLOROPICRIN	00136	0	0	0	0	0	260,000	0	260,000
BEANS	(001200)								
TOXAPHENE	00594	3,638	1,047	0	0	0	0	3,638	1,047
METHOMYL	00383	1,092	2,210	6	13	0	0	1,098	2,223
ENDOSULFAN	00259	195	400	0	0	0	0	195	400
PHOSDRIN-R	00480	189	528	0	100	0	0	189	628
METHYL PARATHION	00394	147	275	25	100	0	0	172	375
CARBARYL	00105	150	75	0	0	8	2	158	77
PHOSDRIN-R, OTHER RELATED	90480	125	628	0	0	0	0	125	628
PARATHION	00459	47	95	50	100	0	0	97	195
BEETS	(001400)								
CARBARYL	00105	1,623	867	0	0	0	0	1,623	867
PARATHION	00459	148	274	0	0	0	0	148	274
METHYL PARATHION	00394	42	170	0	0	0	0	42	170
PHOSDRIN-R	00480	5	15	0	0	0	0	5	15
PHOSDRIN-R, OTHER RELATED	90480	3	15	0	0	0	0	3	15
BERRIES, OTHER	(001500)								
CARBARYL	00105	0	0	11	11	0	0	11	11
PARAQUAT DICHLORIDE	01601	0	0	3	12	0	0	3	12
BIRDSFOOT TREFOIL	(001600)								
PARAQUAT DICHLORIDE	01601	19	101	0	0	0	0	19	101
BROCCOLI	(001700)								
MONITOR-R	01697	215	275	0	0	0	0	215	275
METHOMYL	00383	87	152	0	0	0	0	87	152
PHOSDRIN-R	00480	48	80	0	0	0	0	48	80
PHOSDRIN-R, OTHER RELATED	90480	32	80	0	0	0	0	32	80
DEMETON	00566	4	3	0	0	0	0	4	3
BRUSSELS SPROUTS	(001800)								
METHOMYL	00383	6	13	0	0	0	0	6	13
PHOSDRIN-R	00480	4	6	0	0	0	0	4	6
PHOSDRIN-R, OTHER RELATED	90480	2	6	0	0	0	0	2	6

CABBAGE	(002100)								
METHOMYL	00383	38	81	0	0	0	0	38	81
PHOSDRIN-R	00480	36	71	0	0	0	0	36	71
TOXAPHENE	00594	28	7	0	0	0	0	28	7
PHOSDRIN-R, OTHER RELATED	90480	24	71	0	0	0	0	24	71
CARBARYL	00105	18	18	0	0	0	0	18	18
ENDOSULFAN	00259	0	0	8	10	1	2	9	12
CARROT	(002200)								
TOXAPHENE	00594	296	93	0	0	0	0	296	93
PHOSDRIN-R	00480	91	302	0	0	0	0	91	302
PHOSDRIN-R, OTHER RELATED	90480	60	302	0	0	0	0	60	302
ENDOSULFAN	00259	49	99	0	0	0	0	49	99
CATTLE, BEEF AND DAIRY	(002400)								
-L- TOXAPHENE	00594	0	0	0	8	0	0	0	8
-L- LINDANE	00359	0	0	0	8	0	0	0	8
CAULIFLOWER	(002500)								
METHOMYL	00383	16	36	4,720	1,513	0	0	4,736	1,549
ENDOSULFAN	00259	0	0	291	595	0	0	291	595
CARBARYL	00105	123	98	0	0	0	0	123	98
PARATHION	00459	0	0	47	94	0	0	47	94
PHOSDRIN-R	00480	38	126	0	0	0	0	38	126
PHOSDRIN-R, OTHER RELATED	90480	25	126	0	0	0	0	25	126
CITRUS, OTHER	(003200)								
ETHION	00268	0	0	2,040	340	0	0	2,040	340
PARATHION	00459	0	0	303	80	0	0	303	80
PARAQUAT DICHLORIDE	01601	0	0	10	15	0	0	10	15
CARBARYL	00105	0	0	2	15	0	0	2	15
CORN	(003800)								
PHORATE	00478	3,024	2,327	36	32	0	0	3,060	2,359
CARBARYL	00105	2,565	1,148	9	5	0	0	2,574	1,153
PARATHION	00459	624	682	0	0	0	0	624	682
METHOMYL	00383	281	731	22	98	0	0	303	829
DI-SYSTON-R	00230	0	0	248	252	0	0	248	252
TOXAPHENE	00594	0	0	196	98	0	0	196	98
ENDOSULFAN	00259	117	146	0	0	0	0	117	146
DICAMBA, DIMETHYLAMINE SALT	00849	0	0	6	18	0	0	6	18
DICAMBA, DIMETHYLAMINE SALT, 0	90849	0	0	1	18	0	0	1	18
COTTON	(003900)								
TOXAPHENE	00594	75,987	22,355	0	0	0	0	75,987	22,355
PARAQUAT DICHLORIDE	01601	44,130	225,810	237	1,216	125	815	44,492	227,841
AZODRIN-R	00052	13,711	17,356	26,387	26,033	0	0	40,098	43,389
MONITOR-R	01697	27,409	42,398	28	28	93	186	27,530	42,612
ALDICARB	00575	0	0	20,404	13,816	32	50	20,435	13,866
PHORATE	00478	541	593	14,490	17,330	143	220	15,174	18,143
SUPRACIDE-R	01609	8,537	16,476	0	0	147	295	8,685	16,771
METHOMYL	00383	5,284	11,050	0	0	0	0	5,284	11,050
BIDRIN-R	00072	1,351	1,379	3,027	5,646	40	80	4,418	7,104
METHYL PARATHION	00394	3,093	3,886	0	0	0	0	3,093	3,886
PARATHION	00459	1,421	1,328	0	0	0	0	1,421	1,328
CARBARYL	00105	1,068	694	3	10	0	0	1,071	704
DI-SYSTON-R	00230	98	130	747	996	0	0	844	1,126
ENDOSULFAN	00259	583	774	0	0	0	0	583	774
ETHION	00268	380	190	0	0	0	0	380	190
DEMETON	00566	238	214	0	0	0	0	238	214

EPN	00263	25	250	0	0	0	0	25	250
COUNTY AGRICULTURAL COMMISSIONERS	(004000)								
- - METHYL BROMIDE	00385	0	0	0	0	0	0	4,196	0
- - ZINC PHOSPHIDE	00626	0	0	0	0	0	0	127	0
- - STRYCHNINE	00554	0	0	0	0	0	0	27	0
- - 2,4-D, DIMETHYLAMINE SALT	00806	0	0	0	0	0	0	6	0
- - PICLORAM-R	00593	0	0	0	0	0	0	6	0
- - 1080	00633	0	0	0	0	0	0	0	0
CUCUMBER	(004100)								
ENDOSULFAN	00259	24	49	0	0	0	0	24	49
METHYL BROMIDE	00385	0	0	14	4	0	0	14	4
CARBARYL	00105	0	0	0	0	8	0	8	0
METHOMYL	00383	7	15	0	0	0	0	7	15
CHLOROPICRIN	00136	0	0	7	8	0	0	7	8
DECIDUOUS ORNAMENTAL TREES	(004300)								
PARAQUAT DICHLORIDE	01601	0	0	249	529	0	0	249	529
PARATHION	00459	0	0	25	21	0	0	25	21
METHOMYL	00383	0	0	5	11	0	0	5	11
DRIED FRUIT	(004500)								
METHYL BROMIDE	00385	0	0	0	0	1	0	1	0
-C- METHYL BROMIDE	00385	0	0	0	0	10	1,000	10	1,000
PHOSTOXIN-R	00484	2	85	0	0	0	0	2	85
CHLOROPICRIN	00136	0	0	0	0	0	0	0	0
-C- CHLOROPICRIN	00136	0	0	0	0	0	1,000	0	1,000
EGGPLANT	(004700)								
CARBARYL	00105	0	0	31	22	0	2	31	24
ENDOSULFAN	00259	3	6	23	25	0	0	26	31
PHOSDRIN-R	00480	2	6	0	0	0	0	2	6
ETHION	00268	0	0	2	5	0	0	2	5
PHOSDRIN-R, OTHER RELATED	90480	1	6	0	0	0	0	1	6
FALLOW FARM LAND	(005000)								
METHYL BROMIDE	00385	0	0	48,510	799	0	0	48,510	799
CHLOROPICRIN	00136	0	0	21,944	778	0	0	21,944	778
PARAQUAT DICHLORIDE	01601	14,604	51,946	18	80	4	9	14,627	52,034
2,4-D	00636	1,053	663	1,423	544	0	0	2,476	1,207
2,4-D, DIMETHYLAMINE SALT	00806	1,845	2,060	542	150	0	0	2,387	2,210
FIGS	(005300)								
CARBOPHENTHION	00110	315	210	0	0	0	0	315	210
FLOWERS	(005500)								
METHOMYL	00383	95	203	0	0	0	0	95	203
AZODRIN-R	00052	14	16	0	0	0	0	14	16
METHYL BROMIDE	00385	0	0	0	0	10	3	10	3
GARLIC	(005900)								
PARATHION	00459	98	195	0	0	0	0	98	195
GRAPES	(006200)								
CHLORDANE	00130	1,866	670	62,756	21,303	270	135	64,892	22,108
CARBARYL	00105	2,378	1,190	17,744	10,985	263	230	20,384	12,405
DIALIFOR	01799	0	0	14,135	14,187	424	424	14,559	14,611
ENDOSULFAN	00259	36	28	12,060	7,727	93	37	12,189	7,792
PARAQUAT DICHLORIDE	01601	113	300	7,874	11,803	169	847	8,155	12,950

METHOMYL	00383	209	442	7,922	13,220	8	18	8,139	13,680
SODIUM ARSENATE	00283	0	0	5,747	1,256	595	104	6,342	1,360
ETHION	00268	0	0	3,664	2,621	0	0	3,664	2,621
PARATHION	00459	0	0	2,601	1,619	0	0	2,601	1,619
DIALIFOR, OTHER RELATED	91799	0	0	1,571	14,187	47	424	1,618	14,611
GUTHION-R	00314	0	0	1,143	1,200	34	27	1,177	1,227
CARBOPHENTHION	00110	0	0	1,159	2,105	8	17	1,168	2,122
LEAD ARSENATE (STANDARD)	00353	0	0	942	126	0	0	942	126
PHOSDRIN-R	00480	577	960	69	115	0	0	646	1,075
DIELDRIN	00210	0	0	632	1,695	0	0	632	1,695
PHOSDRIN-R, OTHER RELATED	90480	383	960	46	115	0	0	429	1,075
SODIUM ARSENITE	00534	0	0	185	88	0	0	185	88
CHLORDANE, OTHER RELATED	90130	0	0	16	62	0	0	16	62
*C- METHYL BROMIDE	00385	0	0	7	6,000	0	0	7	6,000
IRRIGATION DISTRICTS	(007100)								
- - 2,4-D, ALKANOLAMINE SALTS (ETH	00001	0	0	0	0	0	0	990	0
- - 2,4-D, ISOOCTYL ESTER	00809	0	0	0	0	0	0	19	0
KIWI	(007300)								
METHYL BROMIDE	00385	0	0	0	0	2,010	8	2,010	8
CHLOROPICRIN	00136	0	0	0	0	990	8	990	8
LEMON	(007500)								
SUPRACIDE-R	01689	0	0	236	100	0	0	236	100
PARAQUAT DICHLORIDE	01601	0	0	17	28	0	0	17	28
CARBARYL	00105	0	0	3	20	0	0	3	20
METHOMYL	00383	0	0	2	5	0	0	2	5
LETTUCE (HEAD)	(007600)								
METHOMYL	00383	13,143	23,909	171	317	53	109	13,367	24,415
TOXAPHENE	00594	10,773	2,984	0	0	0	0	10,773	2,984
PARATHION	00459	9,345	19,411	455	733	0	0	9,800	20,144
PHOSDRIN-R	00480	6,948	17,515	0	0	0	0	6,848	17,515
PHOSDRIN-R, OTHER RELATED	90480	4,558	17,515	0	0	0	0	4,558	17,515
ENDOSULFAN	00259	3,968	4,447	115	167	6	8	4,089	4,622
METHYL PARATHION	00394	3,553	13,558	182	482	0	0	3,736	14,040
PHORATE	00478	1,427	1,485	0	0	0	0	1,427	1,485
DEMETON	00566	734	375	0	0	0	0	734	375
CARBARYL	00105	417	266	0	0	0	0	417	266
DIELDRIN	00210	31	84	0	0	0	0	31	84
PARAQUAT DICHLORIDE	01601	11	30	0	0	0	0	11	30
LETTUCE (LEAF)	(007700)								
TOXAPHENE	00594	4,772	1,218	0	0	0	0	4,772	1,218
PHOSDRIN-R	00480	845	2,270	0	0	0	0	845	2,270
PHOSDRIN-R, OTHER RELATED	90480	563	2,270	0	0	0	0	563	2,270
PARATHION	00459	473	1,024	0	0	0	0	473	1,024
METHOMYL	00383	308	685	0	0	0	0	308	685
PHORATE	00478	159	210	0	0	0	0	159	210
ENDOSULFAN	00259	114	161	0	0	0	0	114	161
METHYL PARATHION	00394	39	174	0	0	0	0	39	174
LIVESTOCK BUILDINGS	(007900)								
STRYCHNINE	00554	0	0	0	30	0	0	0	30
MELONS	(008200)								
CARBARYL	00105	10,866	6,993	0	0	0	0	10,866	6,993
ETHION	00268	9,776	9,799	0	0	146	195	9,923	9,994
METHOMYL	00383	2,221	4,590	0	0	0	0	2,221	4,590

ENDOSULFAN	00259	606	656	5	6	8	15	619	677
PHOSDRIN-R	00480	123	458	0	0	0	0	123	458
PHOSDRIN-R, OTHER RELATED	90480	82	458	0	0	0	0	82	458
PARATHION	00459	43	180	0	0	0	0	43	180
METHYL PARATHION	00394	21	180	0	0	0	0	21	180
MISCELLANEOUS	(008400)								
PHORATE	00478	0	0	96	80	0	0	96	80
MUSTARD	(008700)								
PHOSDRIN-R	00480	5	17	0	0	0	0	5	17
PHOSDRIN-R, OTHER RELATED	90480	3	17	0	0	0	0	3	17
NECTARINES	(008800)								
PARATHION	00459	18	29	10,066	6,880	17	9	10,101	6,926
METHOMYL	00383	200	396	1,021	2,010	11	17	1,233	2,423
CARBARYL	00105	300	60	100	28	0	0	400	88
CARBOPHENOTHION	00110	0	0	84	84	0	0	84	84
PARAQUAT DICHLORIDE	01601	0	0	55	231	0	0	55	231
NON-AGRICULTURAL AREAS	(008900)								
PARAQUAT DICHLORIDE	01601	1,198	5,061	118	265	40	40	1,356	5,366
SODIUM ARSENITE	00534	0	0	118	2	0	0	118	2
2,4-D, DIMETHYLAMINE SALT	00806	81	140	19	8	0	0	100	148
2,4-D	00636	0	0	2	2	0	0	2	2
OATS	(009200)								
DI-SYSTON-R	00230	122	135	0	0	0	0	122	135
2,4-D, DIMETHYLAMINE SALT	00806	14	16	2	3	0	0	16	19
OLIVES	(009500)								
CARBARYL	00105	0	0	842	136	0	0	842	136
PARATHION	00459	0	0	258	94	0	0	258	94
PARAQUAT DICHLORIDE	01601	0	0	20	57	0	0	20	57
ONIONS	(009600)								
TOXAPHENE	00594	3,588	1,184	0	0	0	0	3,588	1,184
PARATHION	00459	1,191	1,940	0	0	0	0	1,191	1,940
PHOSDRIN-R	00480	319	1,061	0	0	0	0	319	1,061
GUTHION-R	00314	268	358	0	0	0	0	268	358
CHLOROPICRIN	00136	0	0	219	6	0	0	219	6
PHOSDRIN-R, OTHER RELATED	90480	212	1,061	0	0	0	0	212	1,061
METHYL PARATHION	00394	168	896	0	0	0	0	168	896
METHOMYL	00383	18	41	0	0	0	0	18	41
ORANGE	(009000)								
SUPRACIDE-R	01689	105	35	8,627	3,062	0	0	8,732	3,097
PARATHION	00459	240	120	7,207	2,828	162	50	7,609	2,998
PARAQUAT DICHLORIDE	01601	0	0	6,220	2,870	0	0	6,220	2,870
METHOMYL	00383	152	243	1,397	2,075	0	0	1,549	2,318
CARBARYL	00105	0	0	725	55	0	0	725	55
ETHION	00268	0	0	260	65	0	0	260	65
2,4-D, PROPYL ESTER	01275	0	0	63	913	0	0	63	913
CARBOPHENOTHION	00110	0	0	20	10	0	0	20	10
GUTHION-R	00314	0	0	18	9	0	0	18	9
PHOSPHAMIDON	00482	0	0	16	17	0	0	16	17
AZODRIN-R	00052	0	0	10	20	0	0	10	20
PHOSPHAMIDON, OTHER RELATED	90482	0	0	1	17	0	0	1	17
ORNAMENTALS	(010000)								

CARBARYL	00105	0	0	35	10	0	0	35	10
PASTURE/RANGELAND	(010100)								
PARAQUAT DICHLORIDE	01601	163	500	0	0	0	0	163	500
2,4-D, DIMETHYLAMINE SALT	00806	135	300	28	15	0	0	163	315
2,4-D	00636	18	30	0	0	0	0	18	30
PEACH	(010400)								
PARATHION	00459	253	217	6,642	3,677	0	0	6,894	3,894
CARBARYL	00105	813	283	778	227	0	0	1,592	510
PARAQUAT DICHLORIDE	01601	0	0	924	738	3	50	927	788
GUTHION-R	00314	0	0	490	408	0	0	490	408
SUPRACIDE-R	01689	0	0	149	85	0	0	149	85
TEPP, OTHER RELATED	90577	24	40	0	0	0	0	24	40
TEPP	00577	16	40	0	0	0	0	16	40
ENDOSULFAN	00259	0	0	2	1	0	0	2	1
METHYL PARATHION	00394	0	0	1	1	0	0	1	1
PEAR	(010500)								
PARATHION	00459	0	0	6	5	0	0	6	5
PEAS	(010600)								
MCPA, DIMETHYLAMINE SALT	00786	193	421	0	0	0	0	193	421
MCPA, SODIUM SALT	00788	66	160	0	0	0	0	66	160
PECAN	(010700)								
DI-SYSTON-R	00230	0	0	11	6	0	0	11	6
PEPPERS (BELL)	(010800)								
ENDOSULFAN	00259	390	441	0	0	0	0	390	441
METHOMYL	00383	275	487	68	102	0	0	343	589
CARBARYL	00105	290	145	4	4	0	0	294	149
PHOSDRIN-R	00480	94	135	0	0	0	0	94	135
PHOSDRIN-R, OTHER RELATED	90480	63	135	0	0	0	0	63	135
PARATHION	00459	0	0	50	100	0	0	50	100
PARAQUAT DICHLORIDE	01601	25	100	20	20	0	0	45	120
DEMETON	00566	34	107	0	0	0	0	34	107
PISTACHIO	(011100)								
PARAQUAT DICHLORIDE	01601	0	0	10	40	0	0	10	40
PLUM	(011200)								
PARATHION	00459	54	27	4,903	2,589	20	12	4,977	2,629
CARBARYL	00105	150	102	634	162	0	0	787	264
PARAQUAT DICHLORIDE	01601	0	0	213	615	0	0	213	615
CARBOPHENTHION	00110	0	0	71	69	0	0	71	69
ENDOSULFAN	00259	0	0	50	20	0	0	50	20
DIELDRIN	00210	0	0	2	12	0	0	2	12
POTATO	(011500)								
MONITOR-R	01697	114	110	0	0	0	0	114	114
GUTHION-R	00314	77	110	0	0	0	0	77	110
ALDICARB	00575	0	0	12	4	0	0	12	4
PRUNE	(011800)								
CARBARYL	00105	0	0	140	35	0	0	140	35
PARATHION	00459	0	0	85	58	0	0	85	58
CARBOPHENTHION	00110	0	0	5	5	0	0	5	5
PUMPKINS	(011900)								

CARBARYL	00105	3	3	0	0	0	0	3	3
RESIDENTIAL PEST CONTROL	(012500)								
- - CHLORDANE	00130	0	0	0	0	0	0	1,285	0
- - CARBARYL	00105	0	0	0	0	0	0	386	0
- - 2,4-D, DIMETHYLAMINE SALT	00806	0	0	0	0	0	0	147	0
- - LEAD ARSENATE (STANDARD)	00353	0	0	0	0	0	0	14	0
- - LEAD ARSENATE (BASIC)	00354	0	0	0	0	0	0	10	0
- - ETHION	00268	0	0	0	0	0	0	1	0
RICE	(012600)								
PROPANIL	00503	25,603	6,707	0	0	0	0	25,603	6,707
SOIL FUMIGATION	(013800)								
METHYL BROMIDE	00385	0	0	8,030	34	10,796	515	18,826	550
CHLOROPICRIN	00136	0	0	3,052	32	75	500	3,127	532
SORGHUM	(013900)								
PHORATE	00478	4,005	4,124	0	0	0	0	4,005	4,124
METHYL PARATHION	00394	1,545	315	0	0	0	0	1,545	315
DI-SYSTON-R	00230	1,416	1,564	0	0	0	0	1,416	1,564
METHOMYL	00383	294	767	0	0	0	0	294	767
PARATHION	00459	90	240	0	0	0	0	90	240
DICAMBA, DIMETHYLAMINE SALT	00849	24	80	9	31	0	0	33	111
PHOSDRIN-R	00480	27	180	0	0	0	0	27	180
CARBARYL	00105	19	17	0	0	0	0	19	17
PHOSDRIN-R, OTHER RELATED	90480	18	180	0	0	0	0	18	180
DICAMBA, DIMETHYLAMINE SALT, 0	90849	4	80	2	31	0	0	5	111
SPINACH	(014500)								
PHOSDRIN-R	00480	276	520	2	15	0	0	279	535
METHYL PARATHION	00394	164	300	80	80	0	0	244	380
PHOSDRIN-R, OTHER RELATED	90480	184	520	1	15	0	0	185	535
PARATHION	00459	0	0	164	355	0	0	164	355
CARBARYL	00105	64	16	0	0	0	0	64	16
SQUASH	(014600)								
ENDOSULFAN	00259	32	32	22	22	0	0	54	54
CARBARYL	00105	20	20	0	0	0	0	20	20
METHOMYL	00383	19	30	0	0	0	0	19	30
PHOSDRIN-R	00480	9	30	0	0	0	0	9	30
PHOSDRIN-R, OTHER RELATED	90480	6	30	0	0	0	0	6	30
STRAWBERRIES	(015000)								
METHYL BROMIDE	00385	0	0	41,019	204	41,579	177	82,598	381
CHLOROPICRIN	00136	0	0	19,834	204	9,257	97	29,091	300
CHLORDANE	00130	0	0	190	70	0	0	190	70
CARBARYL	00105	59	29	9	5	0	0	68	34
ENDOSULFAN	00259	0	0	7	7	0	0	7	7
STRUCTURAL CONTROL	(015200)								
- - CHLORDANE	00130	0	0	0	0	0	0	31,404	0
- - METHYL BROMIDE	00385	0	0	0	0	0	0	4,357	0
- - HEPTACHLOR	00317	0	0	0	0	0	0	723	0
- - HEPTACHLOR, OTHER RELATED	90317	0	0	0	0	0	0	270	0
- - CARBARYL	00105	0	0	0	0	0	0	241	0
- - TOXAPHENE	00594	0	0	0	0	0	0	7	0
- - CHLORDANE, OTHER RELATED	90130	0	0	0	0	0	0	0	0
- - AVITROL 200-R	00050	0	0	0	0	0	0	0	0

SUGARBEET	(015500)								
PHORATE	00478	7,540	7,605	8,103	8,100	117	120	15,767	15,905
METHOMYL	00383	5,196	9,840	0	0	0	0	5,196	9,848
CARBARYL	00105	1,879	978	0	0	0	0	1,879	978
ENDOSULFAN	00259	1,414	1,805	0	0	0	0	1,414	1,885
PARATHION	00459	273	569	0	0	0	0	273	569
PARAQUAT DICHLORIDE	01601	64	219	0	0	0	0	64	219
METHYL PARATHION	00394	58	310	0	0	0	0	58	310
SUNFLOWER	(015600)								
SUPRACIDE-R	01689	10	20	0	0	0	0	10	20
SWEET POTATO	(015800)								
CHLOROPICRIN	00136	0	0	0	0	546	2	546	2
TOMATO	(016200)								
TOXAPHENE	00594	69,394	16,331	96	96	0	0	69,490	16,427
METHOMYL	00383	18,456	33,429	71	110	48	105	18,574	33,643
ENDOSULFAN	00259	16,900	19,102	228	419	0	0	17,128	19,521
METHYL BROMIDE	00385	0	0	3,649	25	4,554	19	8,203	44
METHYL PARATHION	00394	3,277	5,203	0	0	0	0	3,277	5,203
PARATHION	00459	2,796	3,500	0	0	0	0	2,796	3,500
CHLOROPICRIN	00136	0	0	822	19	1,533	14	2,355	32
GUTHION-R	00314	2,044	2,316	0	0	0	0	2,044	2,336
CARBARYL	00105	911	474	88	45	5	5	1,004	524
PARAQUAT DICHLORIDE	01601	870	3,015	50	160	0	0	920	3,175
ETHION	00268	40	80	1	2	3	6	44	88
PHOSDRIN-R	00480	8	25	0	0	0	0	8	25
DEMETON	00566	7	30	0	0	0	0	7	30
PHOSDRIN-R, OTHER RELATED	90480	5	25	0	0	0	0	5	25
TURF	(016300)								
DICAMBA, DIMETHYLAMINE SALT	00849	0	0	2	7	0	0	2	7
DICAMBA, DIMETHYLAMINE SALT, O	90849	0	0	0	7	0	0	0	7
UNIVERSITY OF CALIFORNIA	(016600)								
- - ENDOSULFAN	00259	0	0	0	0	0	0	149	0
- - PARAQUAT DICHLORIDE	01601	0	0	0	0	0	0	6	0
VECTOR CONTROL	(017700)								
- - PARATHION	00459	0	0	0	0	0	0	5,376	0
- - METHYL PARATHION	00394	0	0	0	0	0	0	450	0
- - CARBARYL	00105	0	0	0	0	0	0	150	0
- - CHLORDANE	00130	0	0	0	0	0	0	16	0
WALNUT	(017800)								
PARAQUAT DICHLORIDE	01601	0	0	79	128	0	0	79	128
ENDOSULFAN	00259	0	0	70	35	0	0	70	35
CARBARYL	00105	0	0	40	22	0	0	40	22
GUTHION-R	00314	19	25	17	18	0	0	36	43
PHOSPHAMIDON	00482	15	15	0	0	0	0	15	15
CARBOPHENTHION	00110	0	0	13	22	0	0	13	22
PHOSPHAMIDON, OTHER RELATED	90482	0	15	0	0	0	0	0	15
WATERMELONS	(018000)								
PHOSDRIN-R	00480	12	40	0	0	0	0	12	40
PHOSDRIN-R, OTHER RELATED	90480	8	40	0	0	0	0	8	40
METHOMYL	00383	7	11	0	0	0	0	7	11
WATER RESOURSES	(018100)								

- - CARBON DISULFIDE	00108	0	0	0	0	0	0	202	0
- - ZINC PHOSPHIDE	00626	0	0	0	0	0	0	2	0
- - CHLORDANE	00130	0	0	0	0	0	0	1	0
WHEAT	(018200)								
PHORATE	00478	7,137	7,480	262	259	0	0	7,399	7,739
2,4-D, DIMETHYLAMINE SALT	00806	7,253	8,577	90	150	0	0	7,343	8,727
DI-SYSTON-R	00230	2,922	3,956	0	0	1,125	1,250	4,047	5,206
2,4-D, ALKANOLAMINE SALTS (ETH	00801	3,218	3,451	0	0	0	0	3,218	3,451
MCPA, DIMETHYLAMINE SALT	00786	3,163	7,575	0	0	0	C	3,163	7,575
PARATHION	00459	829	2,211	0	0	0	0	829	2,211
METHYL PARATHION	00394	502	2,882	0	0	45	273	548	3,155
2,4-D	00636	406	450	0	0	0	0	406	450
2,4-D, BUTYL ESTER	00804	256	182	0	0	0	0	256	182
PARAQUAT DICHLORIDE	01601	42	166	0	0	0	0	42	166
METHYL BROMIDE	00385	0	0	6	1	0	0	6	1
DEMETON	00566	3	40	0	0	0	0	3	40

APPENDIX G

EMISSION CALCULATION DATA AND EXAMPLES

TABLE G-1

Vapor Pressures of Pesticides

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (^oC)	Reference Compound	Reference
INSECTICIDES					
Acephate	183.2	1.7×10^{-6}	24	---	1
Aldicarb	190.3	5×10^{-2}	20	---	1
Azodrin-R	223.2	7×10^{-7}	20	---	1
Bidrin-R	237.2	1×10^{-4}	20	---	1
BTB	---	Negligible	--	Bacterium	-
Carbaryl	201.2	4×10^{-5}	25	---	1
Carbofuran	221.3	2×10^{-5}	33	---	1
Carbophenothion	342.9	3×10^{-7}	20	---	1
Chlordane	409.8	1×10^{-5}	25	---	1
Chlorobenzilate	325.2	2.2×10^{-6}	20	---	1
Demeton	258.3	2.48×10^{-4}	20	---	1
Dialifor	393.8	1×10^{-6} (a)	20	Plondrel	1

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (^oC)	Reference Compound	Reference
INSECTICIDES (Continued)					
Diazinon	304.3	1.4×10^{-4}	20	---	1
Dieldrin	380.9	7.78×10^{-7}	25	---	1
Dimethoate	229.2	8.5×10^{-6}	25	---	1
Dioxathion	456.5	1×10^{-5} (a)	25	Malathion	1
Disyston-R	274.4	1.8×10^{-4}	20	---	1
Dursban-R	350.6	1.87×10^{-5}	25	---	1
Dylox-R	257.4	7.8×10^{-6}	20	---	1
Endosulfan	406.9	1×10^{-5}	25	---	1
Ethion	384.5	1.5×10^{-6}	25	---	1
Formetanate Hydrochloride	221.3	Negligible	--	---	1
Fundal-R	196.7	3.6×10^{-4}	20	---	1
Guthion	317.3	2.2×10^{-7}	20	---	2

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (°C)	Reference Compound	Reference
INSECTICIDES (Continued)					
Imidan-R	317.3	1×10^{-3}	50	---	1
Kelthane-R	370.5	5.7×10^{-7} (a)	20	DDT	1
Malathion	330.4	4×10^{-5}	30	---	1
Metasystox-R	260.3	4.7×10^{-6} (a)	20	Metasystox-S	1
Methomyl	162.2	5×10^{-5}	25	---	1
Methoxychlor	345.7	5.7×10^{-7} (a)	20	DDT	1
Methyl Parathion	263.2	9.7×10^{-6}	20	---	1
Monitor-R	141.1	3×10^{-3}	30	---	1
Morestan-R	234.3	2×10^{-7}	20	---	1
Naled	380.8	2×10^{-3}	20	---	1
Omite	350.5	1×10^{-7} (a)	25	---	1
Parathion	291.3	3.78×10^{-5}	20	---	1
Phorate	260.4	8.4×10^{-4}	20	---	1

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (°C)	Reference Compound	Reference
INSECTICIDES (Continued)					
Phosalone	367.8	Negligible	--	---	1
Phosdrin-R	224.1	1×10^{-6} (a)	20	Phosphamidon	1
Plictran	385.2	Negligible	--	---	1
Supracide-R	302.3	1×10^{-6}	20	---	1
TEPP	290.2	1.55×10^{-4}	20	---	1
Tetradifon	356.0	2.4×10^{-10}	20	---	1
Toxaphene	413.8	0.3	25	---	1
HERBICIDES					
Alachlor	269.8	1.3×10^{-5} (a)	20	Metolachlor	1
Avadex BW-R	304.7	2.3×10^{-4} (a)	25	Oxamyl	1
Balan-R	335.3	3.89×10^{-5}	30		1
Barban	249.1	1.5×10^{-5} (a)	24	Linuron	1
Bromacil	261.1	8×10^{-4} (a)	100	---	1

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (°C)	Reference Compound	Reference
HERBICIDES (Continued)					
Bromoxynil Octanoate	403	5×10^{-7} (a)	20	---	1
CDEC	223.8	2.2×10^{-3}	20	---	1
CIPC	213.7	3×10^{-7}	25	---	1
Cobex-R	322.2	3.6×10^{-6}	25	---	1
2,4-D	221.1	0.4	160	---	1
Dacthal-R	332	0.1	60	---	1
Dalapon	143	1.0 (a)	20	Propionic Acid 2-Chloropropane 1,2-Chloropropane	3
Dalapon Sodium Salt	165	1.0 (a)	20	Same as Dalapon	3
2,4-D Amine Salt	235.1	1×10^{-10}	38	---	4
2,4-D Butyl Ester	289.1	8.43×10^{-6}	24.8	---	5
4(2,4-DB) Butoxyethanol Ester	347.1	8.43×10^{-6} (a)	24.8	2,4-D Butyl Ester	5
4(2,4-DB) Diethylamine Salt	293.1	1×10^{-10}	38	2,4-D Amine Salt	4

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (^oC)	Reference Compound	Reference
HERBICIDES (Continued)					
4(2,4-DB) Isooctyl Ester	362.1	8.43×10^{-6} (a)	24.8	2,4-D Butyl Ester	5
Diphenamid	239.3	5×10^{-7} (a)	25	Isoproturon	1
Diuron	233.1	2.7×10^{-7}	30	---	2
DNBP	240.5	2.2×10^{-3} (a)	20	Dinoseb Acetate	1
DMSA	---	Negligible	--	---	6
Endothal	186.2	1×10^{-6} (a)	20	---	1
Eptam-R	189.3	3.4×10^{-3}	35	---	1
IPC	179.2	1×10^{-5} (a)	60	Propanil	1
Kerb-R	256.1	8.5×10^{-5}	25	---	1
Linuron	249.1	1.5×10^{-5}	24	---	1
MCPA Dimethyl Amine Salt	228.6	1×10^{-10} (a)	38	2,4-D Amine Salt	4
MSMA	162	Negligible	--	---	6
2(α-Naphoxy)N,N-Diethyl Propionomide	271.4	4×10^{-5}	25	---	1

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (°C)	Reference Compound	Reference
HERBICIDES (Continued)					
N-sec-Butyl-4-tert-Butyl-2,6-Dinitroaniline	270.3	1×10^{-6} (a)	20	Benfluralin Enthalfluralin Nitralin	1
Ordram-R	187.3	5.6×10^{-3}	25	---	1
Oryzalin	346.4	1×10^{-7} (a)	20	Nitralin	1
Phenmediphan	300.3	1×10^{-11}	25	---	1
Profluralin	347.3	2×10^{-5}	20	Benfluralin	1
Propanil	218	9×10^{-5}	60	---	1
Pyrazone	221.6	7.4×10^{-2}	40	---	1
Ramrod-R	211.7	2×10^{-2}	110	---	1
Ro-Neet-R	215.4	6.2×10^{-3}	25	---	1
Simazine	201.7	6.1×10^{-9}	20	---	1
Tillam-R	203.3	6.8×10^{-2}	30	---	1
TOK-25-R	284.1	8×10^{-6}	40	---	1

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (^oC)	Reference Compound	Reference
HERBICIDES (Continued)					
Trifluralin	335.3	4×10^{-5}	20	---	2
FUNGICIDES					
Benomyl	290.3	Negligible	--	---	1
Botran-R	207.0	1.2×10^{-6}	20	---	1
Captan	300.6	1×10^{-5}	25	---	1
Carbolic Acid	94.1	1.0	40	---	3
Carboxin	235.3	7.66×10^{-3} (a)	100	Pyracarbolid	1
Chlorothalonil	265.9	0.01	40	---	1
Difolatan-R	349.1	Negligible	--	---	1
Dyrene-R	275.5	Negligible (a)	--	---	1
Maneb	265.3	Negligible (a)	--	Zineb	1
Nabam	256.3	Negligible (a)	--	Thiram	1
PCNB	206.1	1×10^{-6}	20	---	1

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (°C)	Reference Compound	Reference
FUNGICIDES (Continued)					
Terrazole-R	247.5	1×10^{-4}	20	---	1
Topsin-M-R	370.4	Negligible (a)	--	Thiram	1
Zineb	275.8	Negligible	--	---	1
Ziram	305.8	Negligible	--	---	1
NEMATOCIDES					
Chloropicrin	164.4	16.9	20	---	2
DBCP	236	0.8	21	---	1
D-D Mixture	113	35	20	---	1
Ethylene Dibromide	187.9	11	25	---	1
Methyl Bromide	94.9	1380	20	---	2
Telone-R	111	18.5	20	---	2
RODENTOCIDES					
Diphacinone	340.4	1×10^{-7}	20	Ditalimfos	1

(a) Vapor pressures estimated.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (^{o}C)	Reference Compound	Reference
PLANT GROWTH REGULATORS					
Ethephon	61.1	Negligible (a)	--	---	-
Gibberellins	346	Negligible (a)	--	---	-
Maleic Hydrazide	---	Negligible	--	---	6
Diethanol Amine Salt	---	---	--	---	-
ADJUVANTS					
Alkyl Polyoxyethylene Ether	---	Negligible (a)	--	(c)	-
2-Chloro-4-phenylphenol	206.7	1.0	120	4,Chlorophenyl-phenol	3
Diethylamine Salt of Coconut Fatty Acid	---	Negligible (a)	--	(c)	-
Nonylphenol Polyoxyethylene	---	Negligible (a)	--	(c)	-
Sodium Xylensulfonate	207	1.0 (a)	66	Benzenesulfonyl-chloride	3
Triethanolamine	149.1	1.0×10^{-2}	20	Pebalate	7

(a) Vapor pressures estimated.
(c) Polymers of unknown molecular weight are assumed to be nonvolatile.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (°C)	Reference Compound	Reference
ADJUVANTS (Continued)					
Vinyl Polymer	---	Negligible (a)	--	(c)	-
DEFOLIANTS					
Cacodylic Acid	138	Negligible (a)	--	MSMA	6
DEF-Defoliant	314.5	5×10^{-6}	20	Metasystox-S	1
Folex-R	298.5	1.5×10^{-5}	27	Aphidan	1
Sodium Cacodylate	160	Negligible (a)	--	MSMA	6
INERT ORGANIC INGREDIENTS					
Butyrolactone	86.1	4.0 (a)	29.6	Methyl butarate	3
Cyclohexanol	100.1	1.0	21	---	3
Diesel Oil	ca. 200	8×10^{-3}	20	---	9, 8 (b)
Diethylenetriamine	103.2	0.2	20	---	7
Dupanol	---	Negligible	--	---	-

(a) Vapor pressures estimated.
(b) Some references are for molecular weight estimates.
(c) Polymers of unknown molecular weight are assumed to be nonvolatile.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (^oC)	Reference Compound	Reference
INERT ORGANIC INGREDIENTS (Continued)					
Emulsifier	---	Negligible	--	---	-
Ethylene glycol	67.1	0.5	20	---	7
Isopropanol	60.1	32	20	---	7
Methyl Cellosolve	79.1	6.2	20	---	7
Methyl Isobutyl Ketone	86.1	8.7	20	---	7
Paraffin	---	Negligible	--	---	7
Propylene Glycol	79.1	0.2	20	---	7
Technical Inerts	130	2 (a)	20	---	-
Toluene	92.1	22	20	---	7
Xylene	106.2	40	55	---	3
NONSYNTHETIC ORGANICS					
Aromatic Petroleum Solvent	ca. 108	2-4 (a)	20	Xylene, Heptane, Octane	3, 8, 9, 12 (b)

(a) Vapor pressures estimated.
(b) Some references are for molecular weight estimates.

TABLE G-1 (Continued)

Pesticide Compound	Molecular Weight	Vapor Pressure (mm Hg)	Temperature (^oC)	Reference Compound	Reference
NONSYNTHETIC ORGANICS (Continued)					
Mineral Oil	ca. 296	7.5×10^{-5} (a)	20	Heneicosane Docosane	3, 9, 11, 12 (b)
Petroleum Distillates	ca. 162	0.22 (a)	20	Hendecane Dodecane	3, 9, 12 (b)
Petroleum Distillate, Aromatic	ca. 162	0.22 (a)	20	Hendecane Dodecane	3, 9, 12 (b)
Petroleum Hydrocarbons	ca. 275	8.5×10^{-4} (a)	20	Nonadecane Heneicosane	3, 9, 11, 12 (b)
Petroleum Oil, Unclassified	ca. 296	7.5×10^{-5} (a)	20	Heneicosane Docosane	3, 9, 11, 12 (b)
Xylene	106	6.0	20	----	3, 12 (b)
Xylene Range Aromatic Solvents	ca. 108	2.4 (a)	20	Xylene, Heptane, Octane	3, 9, 12 (b)

(a) Vapor pressures estimated.
(b) Some references are for molecular weight estimates.

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SAMPLE EMISSION CALCULATIONS

Calculation methods with final results and tables of intermediate values are shown for one insecticide and one herbicide for estimated hydrocarbon emissions from Fresno County applications in 1976.

The methods follow procedures described in Section 7.2.1.

Example 1: Acephate, An Insecticide

Acephate: Molecular Weight = 183.2

Vapor Pressure = 1.7×10^{-6} mm Hg at $24^{\circ}C$

Water: Molecular Weight = 18.0

Vapor Pressure = 23.38 mm Hg at $24^{\circ}C$

Values obtained in the calculations are entered in Table G-2.

1. Calculation of Maximum Emission Rate (E_p).

   E_p is calculated from Equation 7-1,

$$E_p = \frac{E_A}{1 - R.H.} \times \frac{P_i(M_i)^{\frac{1}{2}}}{P_w(M_w)^{\frac{1}{2}}} \qquad \text{(Eq. 7-1)}$$

   E_A for an insecticide equals 0.73 x the water evaporation rate. Water evaporation was 14.71 inches in July, 1976. One inch of water over one acre equals 226,600 pounds; therefore,

$$E_A = 0.73 \times 14.71 \times 226{,}600$$

   Average relative humidity (R.H.) in July was 44 percent. Substituting these values in Equation 7-1 above,

$$E_p = \frac{0.73(14.71)(226{,}600)}{1 - .44} \times \frac{1.7 \times 10^{-6}(183.1)^{\frac{1}{2}}}{23.38(18)^{\frac{1}{2}}}$$

TABLE G-2

Calculation of Emissions from Acephate Application. The Top Number is Lbs.; The Lower Number in () is Acreage.

Entrees	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Total
A Acres							69 (88)	129 (158)	5498 (7549)	1124 (908)			6820 (8703)
A'							63	120	5115	1077			
A"							60	115	4911	1033			
A"/acres							.682	.728	.650	1.14			
E_p							1.01	.959	.838	.569	.478	.222	
Emission/acre							.682	.728	.650	.569			
Carryover from October											.571	.091	
Carryover Emission x acres											423	83	
Emission/acre x acres							60	115	4907	517			
Emission during Application							6	9	383	47			
Total Monthly Emission							66	124	5291	564	423	83	6551

Percent of Applied = 96

$$E_p = 4,345,176 \times .23195 \times 10^{-6}$$

$$E_p = 1.01 \text{ lbs/acre/month in July}$$

E_p values for other months were calculated in the same way with appropriate relative humidity and water evaporation values.

2. Calculation of Evaporation During Application.

The vapor pressure (V.P.) of acephate at $20^{o}C$ was calculated from the following presumed relationship:

$$\frac{\text{V.P. water } 20^{o}}{\text{V.P. water } 24^{o}} = \frac{\text{V.P. acephate } 20^{o}}{\text{V.P. acephate } 24^{o}}$$

From this proportionality,

$$\text{V.P. of acephate } (20^{o}) = \frac{17.535}{23.38} \times 1.7 \times 10^{-6} = 1.33 \times 10^{-6} \text{ mm Hg}$$

The log of acephate V.P. = log $(1.33 \times 10^{-6}) = -5.876$. The July temperature in Fresno County was $26.3^{o}C$. The acephate applied in July was 69 pounds (A in Table G-2). Placing these values in Equation 6-28 where A' equals the amount of pesticide deposited on soil or other surfaces, we have:

$$A' = 69 - 69\left[(4.625)(-5.876 + 7)(.0024)(26.3)^{2}(.01)\right]$$

$$A' = 69 - 5.95 = 63.05$$

Evaporation during application = A - A' and for the July application of acephate:

$$A - A' = 69 - 63.05 = 5.95 \text{ lbs.}$$

3. Calculation of Estimate of Pesticide Removed by Sorption and Biodegradation During Month of Application.

Since the vapor pressure of acephate is less than 1.0 mm Hg and it is not known to be highly persistent nor in a rapidly biodegradable category, adsorption and biodegradation are each calculated as 2 percent of the amount of acephate deposited (A').

Where A'' is the amount of pesticide available for emission from the surface deposit:

$$A'' = A' - .02A' - .02A'$$

and using the value above for A',

$$A'' = 63 - (.02)63 - (.02)63$$

$$A'' = 60.48$$

4. Calculation of Emissions During the Month of Pesticide Application

Values for A', $A - A'$, A'', A''/acre, and E_p were calculated for each month of acephate application and entered in Table G-2. Because the maximum evaporation rate, E_p, is greater than A''/acre for July, August, and September, A''/acre x acres is the emission from deposited pesticide for those months and there is no carryover to the following months. Since A''/acre for October was larger than E_p, the emission for October was E_p x acres of application in that month and there was a carryover of unevaporated pesticide into November.

5. Calculation of Carryover of Pesticide Not Evaporated During the Month of Application.

The pesticide carryover per acre is (A''/acre - E_p) for the first month of carryover, or for acephate carryover from October, (1.14 - .569) = .571 lbs/acre. This is again larger than the E_p for November of .478 lbs/acre, so there is a further carryover. Carryover after the first time is equal to (the previous carryover - E_p) 0.98. Multiplying by 0.98 gives a value of 2 percent smaller to account for the biodegradation loss of 2 percent per month. The carryover of .091 lbs/acre to December was smaller than E_p, and therefore represents the emission rate for the month. The total pounds of emission from carryover equals the pounds of emission per acre in any month times the acres under the month it was applied, in this case the 908 acres in October.

6. Calculation of Total Monthly Emissions.

   Total monthly emission is the sum of carryover emissions times acres, emissions/acre x acre (for the month of application) and the emission during application listed in Table G-2.

Example 2: CIPC, An Herbicide

CIPC: Molecular Weight = 213.7

Vapor Pressure = 3×10^{-7} mm Hg at $25^{\circ}C$

Water: Molecular Weight = 18.0

Vapor Pressure = 23.756 mm Hg at $25^{\circ}C$

Values obtained in the calculation are entered in Table G-3.

1. Calculation of E_p (Maximum Evaporation Rate).

   E_p for herbicide is 0.40 x water evaporation rate. Water evaporation was 10.81 inches in May, 1976, and relative humidity was 44 percent. By substitution of these values in Equation 7-1, we obtain:

$$E_p = \frac{(.40)(10.81)(226,600)}{(1 - .44)} \times \frac{3 \times 10^{-7}(213.7)^{\frac{1}{2}}}{23.756(18)^{\frac{1}{2}}}$$

$$E_p = 1,749,675.7 \times .4344 \times 10^{-7}$$

$$E_p = 0.0762 \text{ lbs/acre/month in May}$$

2. Calculation of Evaporation During Application.

The vapor pressure (V.P.) of CIPC at 20°C was calculated from the following presumed relationship:

$$\frac{\text{V.P. water } 20^o}{\text{V.P. water } 25^o} = \frac{\text{V.P. CIPC } 20^o}{\text{V.P. CIPC } 25^o}$$

$$\text{V.P. of CIPC } (20^o) = \frac{17.535}{23.756} \times 3 \times 10^{-7} = 2.21 \times 10^{-7} \text{ mm Hg}$$

The log of CIPC V.P. = log (2.2×10^{-7}) = .3424 - 7 = -6.658. The Fresno May temperature was 20.9°C. The CIPC applied in May was 872 pounds (under A in Table G-3). Placing these values in Equation 6-28 where A' equals the amount of pesticide deposited, we have:

$$A' = 872 - 872\left[(4.525)(-6.658 + 7)(.0024)(20.9)^2(.01)\right]$$

$$A' = 872 - 14.48 = 857.52$$

Evaporation during application = A - A' and for the May application of CIPC:

$$A - A' = 872 - 857.5 = 14.5 \text{ lbs}$$

3. Calculation of Estimate of Pesticide Removed by Sorption and Biodegradation During Month of Application.

Since the vapor pressure of CIPC is less than 1.0 mm Hg and it is not highly persistent nor rapidly biodegradable, 2 percent is subtracted for adsorption and 2 percent is subtracted for biodegradation

TABLE G-3

Calculation of Emissions from CIPC Application (Values in Pounds)

Entrees	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
A					872						58	660	1590
Acres					166						30	219	
A'					857.5						57.7	658	
A"					823						55.4	632	
A"/acre					4.96						1.85	2.89	
E_p	.0278	.0471	.0465	.0543	.0762	.0835	.1036	.0945	.0826	.0561	.0461	.0220	
Emission/acre					.0762						.0461	.0220	
Carryover = 2% from:													
May	3.813	3.709	3.587	3.468		4.892	4.710	4.512	4.326	4.157	4.107	3.905	
Nov.	1.746	1.683	1.604	1.529	1.442	1.339	1.230	1.104	.9867	.8860		1.804	
Dec.	2.868	2.783	2.682	2.582	2.478	2.401	2.271	2.124	1.989	1.869	1.776		
Sum of Carryover Emissions	11.4	19.5	19.3	22.5	19.0	34.7	43.0	39.2	34.3	23.3	17.7	4.3	
Emission/acre x acres					12.6						1.4	4.8	
Emission during Application					14.5						0.3	2.0	
Total Monthly Emissions	11	19	19	22	47	35	43	39	34	23	19	11	322

Percent of Applied = 20

from the pounds of CIPC deposited (A'). Where A" is the amount of pesticide remaining available for emission from the surface deposit:

$$A'' = A' - .02A' - .02A'$$

Substituting the value of A' above,

$$A'' = 857.5 - .02(857.5) - .02(857.5)$$

$$A'' = 823.2$$

4. Calculation of Emissions During the Month of Pesticide Application. Values for A', A - A', A", A"/acre, and E_p were calculated for each month of CIPC application and entered in Table G-3. Because the A"/acre in May is greater than the maximum evaporation rate (E_p) for that month, there is a carryover of CIPC to the next month. The emission from application during May was calculated as emission/acre x the acres in that application or (.0762)(166) = 12.6 lbs. Calculations were made in the same way for the other two months in which CIPC was applied and there was also a carryover of unevaporated pesticide from those applications.

5. Calculation of Carryover of Pesticide Not Evaporated During the Month of Application.

   The pesticide carryover per acre is (A"/acre - E_p) for the first month of carryover, or for CIPC carryover from May, (4.96 - .0762) = 4.884 lbs/acre. This again is larger than the E_p for June of .0835 lbs/acre, so there is further carryover. Carryover after the first time is equal to (the previous carryover - E_p) 0.98. Multiplying by 0.98 gives a value 2 percent smaller to account for the biodegradation loss of 2 percent per month. The carryover to July and subsequent months was in each case larger than E_p for each month.

The carryover was continued for each month until December, 1976, and then carryover from December was brought to January, 1976, and calculations continued for a total of 12 months. The carryover from December back to January was done on the assumption that the application in 1975 would have been similar to the 1976 application and emissions would continue throughout the year. Carryover from November and December was treated in the same way as carryover from May. Carryover was carried to 12 months for each month of application. The emission for each month that there was carryover is equal to E_p for that month times the acres treated in the month of application. For example, from the carryover to January of 3.796 lbs. from the May application, the emission equals .0278 x 166 = 4.6 lbs.

6. Calculation of Total Monthly Emissions.

   The total emissions for each month was equal to the sum of carryover emissions, emissions per acre x acres, and emission during application.

APPENDIX H

1976 MONTHLY DISTRIBUTION OF PESTICIDE EMISSIONS

IN FRESNO COUNTY

TABLE H-1. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH SYNTHETIC ORGANIC PESTICIDE PRODUCTS FOR ACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
INSECTICIDES														
Chlordane	3	733	7208	62765	716								2507	73929 (97)
Chlorbenzilate	2(?)							113	113	528				754 (96)
Dieldrin	3	13	200	183	34	36	40	50	10	2	37	22	10	637 (84)
Endosulfan	3		2	208	359	2946	14107	23310	8685	2916	2171		1	54604 (96)
Kelthane-R	1	3	5	6	330	5617	26363	44198	19442	2807	244	60	3	99079 (88)
Methoxychlor	3			2288	3541	3467	481	162	628	216	51	30		10864 (95)
Tetradifon	3						0	0	0					0
Toxaphene	3	1692	227			1224	45249	76061	66106	16797	1386	32	371	209645 (100)
Acephate	3							66	124	5291	564	423	83	6551 (96)
Azodrin-R	3				54	8739	19620	14655	216	2				43286 (95)
Bidrin-R	3		171		123	3876	1510	2170	1227	19				9096 (97)
Carbophenothion	3	2	2	16	47	240	488	814	393	99	4	3	2	2110 (95)
Demeton-I	3			11	12	16	59	860	74	298				1330 (97)
Dialifor	2				162	10527	10386	649	3					21727 (92)
Diazinon	3	3010	3990	6218	10870	14126	1502	1739	8219	3795	11	711	2615	56856 (96)
Dimethoate	3	98			343	27041	62241	45143	14163	2792	582	16	57	152476 (96)
Dioxathion	3					1483	170							1653 (96)
Disyston-R	3				16237	1178	10	293	1725	224				19667 (96)
Dursban-R	3						1050	5942	1632	507				9131 (97)
Dylox-R	3						1403	1298	3888	1008				7597 (96)
Ethion	3					1559	4982	7373	3630	647	89			18280 (98)
Guthion	3				28	7036	752	2302	1071	67				11756 (96)
Imidan-R	3	341	149	6137	2616	1117	1251	3130	1014					15755 (94)
Malathion	3			35	311	185	6342	8235	2877	1961	24150			44596 (96)
Metasystox	3			26	143	164	361	2594	2884	2768		50	291	9281 (96)
Methyl Parathion	3	87	1	1811	8720	1325	2001	3461	11692	4133	327	24	190	33772 (96)
Monitor-R	3						13	5110	25029	192	209			30553 (97)
Naled	3				226	265	1384	24829	34511	5130	138	15		66498 (97)
Parathion	3	5440	10689	9145	8816	7147	5181	5378	7035	9664	2292	421	1376	72584 (96)
Phorate	3	2807	1655	10172	32118	9721	731	1599	4880	1311	161	78	183	65916 (96)

TABLE H-1. CONTINUED

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
INSECTICIDES (Continued)														
Phosdrin-R	3	254	773	1459	3314	2161	354	2489	1525	3496	5867	2515	456	25763 (96)
Supracide-R	3	190	33	61	140	4673	3636	2220	12469	770	500	402	192	25336 (96)
TEPP	3					493	3058	19470	5550					28571 (97)
Aldicarb	3			1116	1565	1429	16714	1903	14					22741 (97)
Carbaryl	3			1254	821	3893	6223	15256	20236	5332	96	241	38	53390 (96)
Carbofuran	3		131	6012	1103	627			22					7895 (96)
Methyomyl	3			1724	1290	1572	5150	25792	25690	11909	5578	4667	20	83392 (96)
Morestan-R	2(?)				27	519								546 (96)
Fundal-R	3					1198	978	13252	40321	1051				56800 (97)
Omite	3		104		35	7249	38307	194469	86504	385	1935			329488 (96)
<u>SUBTOTAL:</u>		14670	25390	110647	94601	132749	282097	556936	413602	37117	47392	9810	3895	1783906
HERBICIDES														
4(2,4-DB) Butoxyethanol Ester	3			7								142		149 (69)
2,4-D	3		4267	1487					237	607	1392	409	184	8583 (71)
2,4-D Amine Salt	3	111	20879	41279	74						154	702	1104	64303 (68)
2,4-D Butyl Ester	3			2167										2167 (69)
4(2,4-DB) Dimethylamine Salt	3	29		181										210 (69)
4(2,4-DB) Isooctyl	3	414	358	676							444	154	172	2218 (68)
MCPA Dimethylamine Salt	3		2506	3650										6156 (68)
Alachlor	3					1359								1359 (96)
Diphenamid	3	125	192	175	208	292	321	397	363	318	215	176	84	2867 (34)
Kerb-R	3								655		181	1178	460	2474 (96)
2(α-Naphthoxy)-N,N-Diethyl Propionamide	2(?)	7084	2797	245	12						731	254	364	11497 (96)
Propanil	3					3678	26647	5967						36292 (97)
Ramrod-R	3						1663							1663 (97)
Balan-R	1	1375	588	390	21				754	675	1486	1627	844	7760 (96)
Cobex-R	2(?)			140	21									161 (96)
Trifluralin	1	3431	2089	3665	5919	3988	1544	512	40	13	2825	4085	3557	37673 (96)
Simazine	1	16	23	29	32	45	50	62	56	19	33	27	13	440 (2)

TABLE H-1. CONTINUED

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
HERBICIDES (Continued)														
Diuron	3	481	797	785	915	1286	1477	1752	1596	1354	951	781	397	12572 (27)
Linuron	3			77		141								218 (96)
Bromacil	3	3		40	35						344	1161	63	1646 (96)
Pyrazone	3	2155		101	299						322	640		3517 (96)
2,2-Dichloro-propionic Acid	2				217	239	26					31		513 (96)
Dalapon, Sodium Salt	2	449	344	239	4379	2766	153					183		8513 (96)
Dacthal-R	2	9876	518	1075	5692	4440			1602		7009	2065	2766	35043 (96)
DNBP	2(?)	6073	2295	2730	1444	2623	582	573	49713	66446	398	496	5271	138644 (97)
Avadex BW-R	3	193												193 (94)
Barban	3	219	1218	318									240	1995 (96)
CDEC	2(?)					352								852 (97)
CIPC	2(?)	11	19	19	22	47	35	43	39	34	23	19	11	322 (20)
Eptam-R	2(?)			688	790	2645	190		1063			874		6450 (96)
IPC	3	99	343	318	396	549	603	703	292	34	38		16	3441 (89)
Ordram-R	3					1779	461	528						2768 (97)
Ro-Neet-R	3					3412	117							3529 (96)
Tillam-R	3					9016								9016 (97)
N-Sec-Butyl-4-Tert-Butyl-2,6-D	3		210											210 (96)
Oryzalin	3	1	2	2	3	4	4	5	5	4	3	2	1	36 (2)
Profluralin	2(?)	152		182	39								497	870 (96)
Tok-25-R	2(?)			884							762			1646 (96)
Endothal	3	48	132	277	341	367	73		1317	4627	7660	439		15331 (96)
Bromoxynil Octanoate	3	8	472	738	621	493	105	27	6					2470 (41)
SUBTOTAL:		32347	40093	68753	21467	40001	34030	10544	57715	74196	24958	15441	16036	435581
FUNGICIDES														
Botran-R	1	63	98	97	113	159	2635	2021	4435	2924	467	133		13145 (95)
Chlorothalonil	2(?)				65	730	26132	38322	43501	1329	318			110397 (97)
PCNB	2(?)			238	1226	1114								2578 (96)
Carboxin	3							172	88					260 (97)

TABLE H-1. CONTINUED

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
FUNGICIDES (Continued)														
Captan	3		16649	1947	581	223	7694	6005	23200	28936	4686			39921 (97)
Terrazole-R	3			104	244	141								489 (96)
Carbolic Acid	2(?)		26			382	710	1579	283					2980 (98)
SUBTOTAL:		63	16773	2386	2229	2749	37171	48099	71507	33189	5471	133		219770
NEMATOCIDES														
Chloropicrin	1	1132		1475		93	33220	3	23321		5872	963		66079 (100)
DBCP	2(?)		301	6189	5968	4297		100		632	12940	77162	33736	141325 (100)
D-D Mixture	3	533	15951	485			3101			90062				110132 (100)
Telone-R	3										6760	22129	68430	97319 (100)
Ethylene Di-bromide	1	3693												3693 (100)
Methyl Bromide	1	9222		5365	26861	4182	64741	374	48522		13205	9140		181612 (100)
SUBTOTAL:		14580	16252	13514	32829	8572	101062	477	71843	90694	38777	109394	102166	600160
ADJUVANTS														
2-Chloro-4-Phenylphenol	2(?)						30	135	250	27				142 (97)
Sodium Xylene-sulfonate	2(?)	21	0		1	37	70	214	51	31	1640	143		2258 (97)
Triethano-lamine	2(?)	37				47	87	269	64	106	2507	217		3334 (94)
SUBTOTAL:		58			1	84	187	618	365	214	4147	360		6034
DEFOLIANTS														
DEF	3									117868	155488	1542		274898 (96)
Folex-R	3	270								35326	97357	1440		134393 (96)
SUBTOTAL:		270								203194	252845	2982		459291
TOTAL:		61988	98508	195300	151127	184155	454547	516674	615032	488604	373590	138120	127097	3504742

TABLE H-2. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH SYNTHETIC ORGANIC PESTICIDE PRODUCTS FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
INSECTICIDES														
Chlordane	3	4480	3192	3869	3588	2934	2895	3184	2739	1133	2065	2670	3011	35800 (96)
Endosulfan	3					162	1							163 (96)
Heptachlor	3					207	207		189	124	139	118	96	1080 (96)
Diazinon	3	268	767	222	273	245	598	507	220	421	163	149	205	4038 (96)
Dursban-R	3	59	21	158	121	84	125	87	335	154	298	286	115	1853 (96)
Fenthion	3					28	73	36	34	3	1			175 (96)
Malathion	3	244	522	777	4913	588	334	444	579	435	16105	904	378	26723 (96)
Methyl Parathion	3							22	76	120	273			491 (96)
Naled	3					28			250	201	260			739 (96)
Parathion	3			112	270	562	1293	1668	1946					5851 (96)
Phorate	3		795	1572										2367 (96)
Baygon-R	3					32	278	595	1013	545	272			2789 (96)
Carbaryl	3	75			10	123	215	182	148	41	163	38	2	997 (95)
Omite	3					13	40	64	28	1				146 (95)
Amines, Aliphatic	2(?)			11	28	40	11	11	425	26	28	15		596 (96)
Carbon Tetrachloride	2(?)											182	364	546 (96)
Carbon Disulfide	1	133	31		13						43			220 (96)
Ethylene Dichloride	1											425	852	1277 (96)
SUBTOTAL:		5259	5313	6731	9216	5096	6570	6800	8032	3204	19810	4788	5023	85847
HERBICIDES														
MCPA, Isooctyl Ester	3							95		16	16			127 (95)
2,4-D Amine Salt	3					8					1422	345		1775 (96)
4(2,4-DB) Butoxyethanol Ester	3								71		28			99 (96)
Diuron	3		6	193	34	46				94	1808	1218		3449 (96)
Monuron	3				1126									1126 (96)
Amitrol	2(?)	116	6	18	103	13	9	24	6	6	351	403	38	1093 (96)
Atrazine	3	748	495	217							16	464	340	2280 (96)
Bromacil	3	77	112	74	16					287	346	1908		2820 (96)
Prometone-R	3	17	712		84				53	10	6	32		914 (96)

TABLE H-2. CONTINUED

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
HERBICIDES (Continued)														
Simazine	1	637	597	33	150	24	39	12	547	167	378	1131	459	4324 (96)
Dalapon, Sodium Salt	1				43		67				11			121 (98)
Fenac	1			43							86	342		971 (96)
2,3,6-TBA, Dimethylamine Salt	2(?)									411	74	74		559 (96)
Dichlobenil	2(?)				140	22			36	3	36	40		282 (96)
Diphenamid	2(?)	113		140	36	39		552	46		22		79	1027 (96)
Bromoxynil Octanoate	2(?)			11	24	189	570	210	771	107	20	22		1924 (96)
1-(5-Tert-Butyl-1,3,4-Thiadiaz	2(?)	389	1199	5	4					65	146	1736	11	3556 (96)
SUBTOTAL:		2097	3227	735	1810	341	735	893	1530	1171	4766	8215	927	25447
FUNGICIDES														
Benomyl	3		11	65	175	140	125	11	96	50	53	130		858 (96)
Botran-R	1					122				182				304 (96)
Dowcide-A-R	1	777		1017	1020	550	1662	621	621	1209	389	1041		3907 (96)
PCNB	2(?)			291										291 (96)
Captan	3			291						61				352 (96)
Thiabendazole-R	3	15		125	1	1	34							176 (96)
Sec-Butylamine	2(?)	2110		1266		949				317	845	2428		7915 (96)
SUBTOTAL:		2902	11	3056	1196	1762	1822	632	717	1819	1287	3599		18803
NEMATOCIDES														
Methyl Bromide	1	7229	10714	4909	4457	4585	3518	4266	2709	5604	9970	12713	4127	74801 (96)
TOTAL:		17487	19270	15431	16679	11784	12645	12591	12988	11798	35833	29315	10077	205898

TABLE H-3. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH INERT ORGANIC INGREDIENTS (FORMULATION CODE 04) FOR ACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Distillate	2	329	366	2786	1396	2363	4370	7363	5714	4919	5705	979	659	36947
	3	1865	2075	15786	7908	13389	24763	41723	32378	27875	32325	5548	3732	209369 (96)
Methyl Oleate	3	1116	1242	9448	4731	7996	14780	24873	19326	16640	19318	3320	2235	125025 (96)
Kerosene	2	434	483	3672	1840	3113	5756	9696	7526	6480	7516	1290	868	48674
	3	651	724	5508	2759	4669	3635	14543	11290	9719	11275	1936	1302	73011 (96)
Xylene	3	192	214	1623	812	1365	2518	4222	3293	2836	3304	570	384	2133 (100)
Cyclohexanone	2	137	152	1158	579	973	1796	3012	2349	2023	2357	407	274	15217 (100)
Technical Inerts	2(?)	81	90	685	342	576	1062	1781	1389	1196	1394	241	162	8999 (100)
Butyrolactone	3	36	40	307	154	260	477	801	624	537	625	108	73	4043 (100)
Isopropanol	3	12	13	99	50	83	154	258	201	173	202	35	23	1303 (100)
Butyl Mercaptan	2	7	8	59	30	50	92	164	120	103	120	21	14	778 (100)
Epichlorohydrin	3	7	8	58	29	49	91	152	118	102	119	20	14	767 (100)
Dibutyl Disulfide	3	3	3	22	12	19	35	59	47	40	46	8	6	300 (100)
Isofuron	3	2	2	17	9	14	26	44	35	30	35	6	4	224 (100)
Benzene	1	1	1	11	6	10	18	29	25	20	21	4	3	149 (100)
Methyl Isobutyl Ketone	3	0	0	2	1	2	3	5	4	4	4	1	1	28 (100)
TOTAL:		4873	5421	41241	20658	34931	64576	108716	84439	72697	84367	14494	9754	546167

TABLE H-4. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH INERT ORGANIC INGREDIENTS (FORMULATION CODE 04) FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Distillate	2	46	29	173	90	143	262	435	341	291	323	65	43	2240
	3	263	165	978	508	813	1485	2463	1929	1651	1827	368	245	12696 (96)
Methyl Oleate	3	163	100	586	305	486	891	1476	1156	988	1095	221	140	7607 (96)
Kerosene	2	59	39	228	118	189	346	573	449	384	425	86	59	2955
	3	89	59	341	178	284	519	859	674	575	638	128	89	4433 (96)
Xylene	3	30	18	100	57	84	153	253	197	169	188	38	22	4433 (100)
Cyclohexanone	2	20	11	72	37	59	109	182	142	122	135	27	18	934 (100)
Technical Inerts	2(?)	12	7	43	22	33	65	108	85	72	80	17	10	554 (100)
Butyrolactone	3	5	3	19	10	16	29	48	38	32	36	7	5	248 (100)
Isopropanol	3	2	1	6	3	5	9	15	12	10	12	2	2	79 (100)

(Continued)

TABLE H-4. CONTINUED

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Butyl Mercap-tan	2	1	1	4	2	3	5	9	7	6	7	1	1	47 (100)
Hexane	3	1	1	4	2	3	5	9	7	6	7	1	1	47 (100)
Epichloro-hydrin	3	1	1	4	2	3	9	9	7	6	7	1	1	51 (100)
Dibutyl Disulfide	3			1	1	1	2	4	3	2	3	1		18 (100)
Isofuron	3			1	1	1	2	3	2	2	2			14 (100)
Benzene	1			1		1	1	2	1	1	1			8 (100)
Methyl Iso-butyl Ketone	3			0	0	0	0	0	0	0	0	0		0
TOTAL:		692	435	2561	1336	2124	3892	6448	5050	4317	4786	963	636	33240

TABLE H-5. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH INERT ORGANIC INGREDIENTS (FORMULATION CODE 39) FOR ACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Methyl Iso-butyl Ketone	3	632	2419	3797	1657	4073	2967	6074	9457	7180	25885	2417	2485	69043 (96)
Butyrolactone	3	459	1782	2802	1224	3005	2192	4484	6978	5297	19103	1792	1335	50943 (100)
Propylene Glycol	3	193	754	1187	519	1286	941	1932	2992	2270	8147	755	775	21751 (96)
Diesel Oil	2	37	144	227	99	246	179	368	571	434	1557	145	149	4156
	3	149	578	909	398	982	717	1472	2284	1734	6228	578	594	16623 (96)
Xylene	3	63	244	384	167	412	300	615	958	725	2621	244	251	6985 (100)
Methyl Cello-solve	3	60	234	367	159	394	298	588	915	695	2506	232	240	6678 (100)
Technical Inerts	3	44	166	260	113	279	204	418	650	493	1778	166	170	4741 (100)
Isopropanol	3	35	139	216	95	232	169	346	538	410	1476	139	140	3935 (100)
Toluene	3	12	49	78	343	95	62	125	195	149	534	49	50	1731 (100)
Ethylene Glycol	3	4	17	26	11	29	21	43	67	50	184	17	17	496 (96)
Diethylene Triamine	3	4	12	20	9	21	15	32	49	38	134	12	13	359 (100)
Cyclohexanol	3	1	5	11	4	11	7	16	25	20	69	8	6	184 (100)
TOTAL:		1693	6544	10284	4798	11055	8062	16513	25679	19506	70222	6544	6725	187625

TABLE H-6. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH INERT ORGANIC INGREDIENTS (FORMULATION CODE 09) FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Methyl Iso-butyl Ketone	3	107	18	197	341	1254	152	116	1258	145	358	163	28	4147 (96)
Butyrolactone	3	82	14	151	262	972	117	89	967	111	275	126	22	3188 (100)
Propylene Glycol	3	34	6	64	110	411	49	37	409	66	116	53	10	1365 (96)
Diesel Oil	2	7	1	12	21	79	9	7	78	9	22	10	2	257
	3	26	5	49	86	315	38	29	314	36	89	41	7	1042 (96)
Xylene	3	4	15	24	10	26	19	39	60	45	160	15	15	32 (100)
Methyl Cello-solve	3	4	14	23	10	24	18	37	58	43	152	14	14	411 (100)
Technical Inerts	3	3	10	15	7	18	12	26	42	31	110	10	10	294 (100)
Isopropanol	3	2	8	13	6	14	10	21	34	25	94	8	8	243 (100)
Toluene	3	1	3	5	21	5	4	8	12	9	35	3	3	109 (100)
Ethylene Glycol	3		1	2	1	2	1	3	4	3	10	1	1	29 (96)
Diethylene Triamine	3		1	1	1	1	1	2	3	2	8	1	1	22 (100)
Cyclohexanol	3			1		1		1	1	1	4			9 (100)
TOTAL:		270	96	557	876	3132	430	415	3240	526	1433	445	121	11541

TABLE H-7. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH NONSYNTHETIC PRODUCTS (AS MINOR ACTIVE INGREDIENTS) FOR ACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petro-leum Solvents	2	1	10	2269	1182	3813	2201	5909	3432	1174	330	1	22674	48996
	3	7	55	12859	6700	21606	12471	39148	47784	5651	1870	4	128489	277644 (100)
Petroleum Distillate	2	130	2247	14963	313	36	2801	3520	3012	1249	0	0	951	29222
	3	23	397	2641	55	6	494	621	532	220	0	0	168	5157 (97)
Petroleum Distillate, Aromatic	2	0	0	2	805	123	117	407	646	301	0	4	25	2430
	3	0	0	11	4564	698	663	2307	3660	1705	0	25	139	13772 (97)
Petroleum Hydrocarbon	2	65	744	841	1313	334	2130	3740	3599	5607	7112	649	763	27397
	3	151	1735	1961	3064	1946	4970	8726	8399	13082	16595	1514	1780	63923 (97)
Petroleum Oil, Unclassified	2	76798	103029	6944	88	13723	5182	5359	5976	8770	9298	1295	34412	270874
	3	13553	18182	1225	16	2422	914	946	1055	1548	1641	229	6073	47804 (95)
Xylene	3	638	1337	3006	5843	8312	14058	27208	21277	8533	5786	322	347	97167 (100)
Xylene Range Aromatic Sol-vent	2	0	28	91	52	273	2484	4061	1345	691	300	0	1	9926
	3	0	111	362	209	1094	9937	16244	7780	2764	1202	0	2	39705 (100)
TOTAL:		91366	127375	47175	24204	54886	58422	119196	114097	52295	44134	4543	195824	934017

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TABLE H-8. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH NONSYNTHETIC PRODUCTS (AS MINOR ACTIVE INGREDIENTS) FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Solvents	2	53	66	56	56	72	144	88	170	117	149	196	119	1296
	3	357	377	320	317	410	819	501	961	662	842	1108	677	7351 (96)
Mineral Oil	2	22	548	27	749	118	47	38	33	0	0	0	0	1582
	3	4	97	5	132	21	8	7	6	0	0	0	0	280 (96)
Petroleum Distillate	2	1118	603	5406	5445	8123	3012	2954	72716	4926	5466	3861	1377	115008
	3	197	106	954	961	1433	532	521	12832	869	965	681	243	20294 (96)
Petroleum Hydrocarbon	2	5	9	3	15	21990	2	2	11	4002	8	3	16	26066
	3	12	20	6	35	51309	5	4	25	9338	20	6	37	60817 (96)
Petroleum Oil, Unclassified	2	1898	2540	940	353	19	171	253	146	21	1712	245	2970	11268
	3	335	448	166	62	3	30	45	26	4	302	43	524	1988 (96)
Xylene	3	99	260	293	334	276	200	136	175	78	141	15	0	2007 (96)
Xylene Range Aromatic Solvent	2									35	40	23	22	120
	3									142	159	92	89	482 (96)
TOTAL:		4110	5074	8175	8460	83774	4970	4549	87101	20194	9804	6273	6074	248559

1.45 TPD

TABLE H-9. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH NONSYNTHETIC PRODUCTS (AS PURE OIL) FOR ACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Solvents	2												253819	253819
	3												1438308	1438308 (100)
Mineral Oil	2	24670	200205	15438	5920			7663						253896
	3	4354	35330	2724	1045			1352						44805 (96)
Petroleum Distillate	2								1616					1616
	3								285					285 (97)
Petroleum Hydrocarbon	2					201858			344762	30163				576783
	3					471002			804446	70379				1345827 (97)
Petroelum Oil, Unclassified	2	341034	886540	28938	5551	125168	33456	20277	55353	31807	22250	16645	718589	2285608
	3	60183	156448	5107	980	22089	5904	3578	9768	5613	3926	2937	126810	403343 (96)
TOTAL:		430241	1278523	52207	13496	820117	39360	32870	1216230	137962	26176	19582	2537526	5604290

~0.27 TPD

TABLE H-10. 1976 MONTHLY DISTRIBUTION OF EMISSIONS ASSOCIATED WITH NONSYNTHETIC PRODUCTS (AS PURE OIL) FOR NONACREAGE APPLICATION IN FRESNO COUNTY (LBS.); (RC = REACTIVITY CLASS); THE UPPER NUMBER IN ANNUAL TOTAL IS LBS.; THE LOWER NUMBER IN () IS PERCENT OF POUNDS APPLIED.

CHEMICALS	RC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
Aromatic Petroleum Solvents	2											68578		68578
	3											388610		388610 (96)
Mineral Oil	2	6939	54100	4337		1658		2137						69171
	3	1225	9547	765		293		377						12207 (96)
Petroleum Distillate	2								448					448
	3								79					79 (96)
Petroleum Hydrocarbon	2					56362			98891	8413				163666
	3					131511			230745	19630				381886 (96)
Petroleum Oil, Unclassified	2	95924	243582	8130	1558	35025	9352	5655	15473	8893	6233	4675	202071	636570
	3	16928	42985	1435	275	6181	1650	998	2731	1569	1100	825	35660	112337 (96)
TOTAL:		121016	350214	14667	1833	231030	11002	9167	348367	38505	7333	462688	237730	1833552